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CHARACTERIZATION OF CONFINED DISPOSAL AREA INFLUENT AND EFFLUEN--ETC(U)
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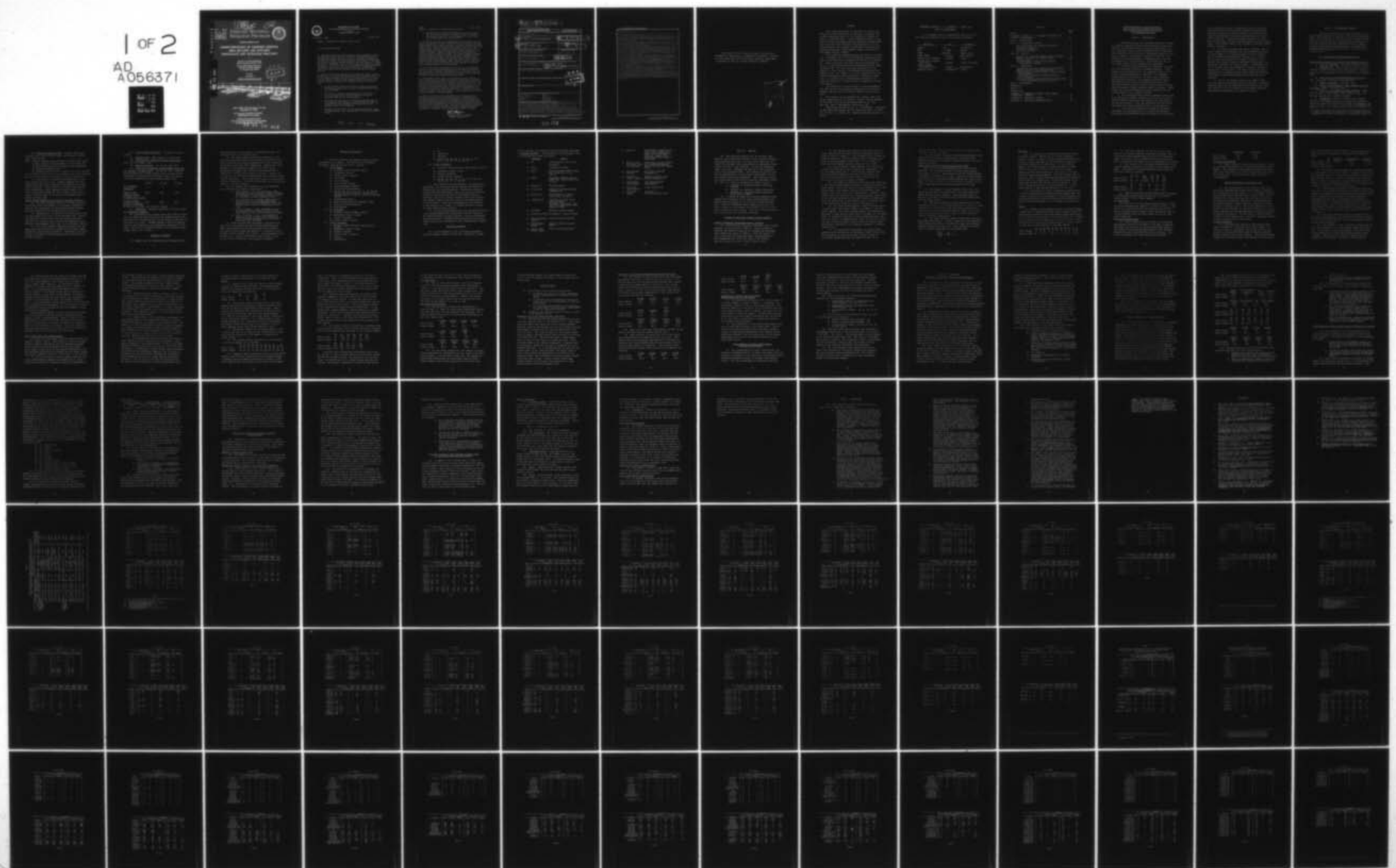

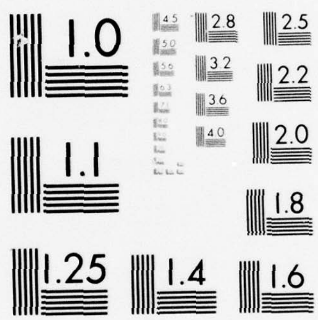

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DREDGED MATERIAL RESEARCH PROGRAM

TECHNICAL REPORT D-78-16

CHARACTERIZATION OF CONFINED DISPOSAL AREA INFLUENT AND EFFLUENT PARTICULATE AND PETROLEUM FRACTIONS

by

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Final Report

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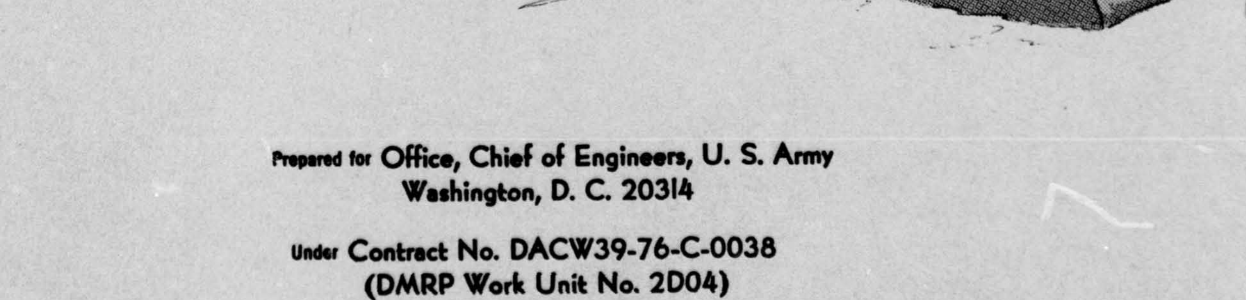

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15 June 1978

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TO: All Report Recipients

1. The study reported on in the technical report transmitted herewith was undertaken as Work Unit 2D04 of Task 2D, Confined Disposal Area Effluent and Leachate Control, of the Corps of Engineers' Dredged Material Research Program. The major purpose of this task was to determine the potential pollution problems created by the land disposal of dredged material in containment areas, both from effluent and subsurface leachate discharges. Task 2D was a part of the Environmental Impacts and Criteria Development Project, which was concerned with the establishment of criteria for open-water and alternative disposal modes for dredged material.

2. Work Unit 2D04 was an extension of Work Unit 2D01, which evaluated the character of influents and effluents in land containment areas. Two island disposal areas were monitored, the brackish water Pinto Island site near Mobile, Alabama, and the freshwater Grassy Island site near Detroit, Michigan, to achieve the following objectives of Work Unit 2D04:

a. Through influent-effluent monitoring, determine the physical and chemical changes that can occur in dredged material during land containment.

b. Use results of effluent and background water monitoring to better characterize the potential impact that effluent discharges might have on receiving waters.

c. Investigate the association of different contaminant species with different sized particles in effluents and determine the relationship between residence time and removal for some parameters such as oil and grease.

d. Determine the association of trace metals and synthetic organochlorine compounds (e.g., PCBs and DDT) with the oil and grease fraction.

e. Evaluate the gross chemical composition of both the influent and effluent oil and grease fractions in order to determine what changes might occur in the composition of their counterparts during retention in disposal areas.

3. The results from this study showed that most trace metals, oil and grease, chlorinated pesticides, and PCBs were almost totally associated with settleable (>8μ) solids in influent, effluent, and background water samples; their removal efficiencies were usually very close to the total solids removal. However, significant quantities of the major ions (calcium, magnesium, sodium, and potassium), ammonium nitrogen, total carbon, and organic carbon were associated with the soluble phase (<0.05μ fraction). Removal efficiency of parameters mainly associated with the soluble phase was much lower than for the parameters mostly bound with settleable solids. The concentration of soluble trace metals measured in micrograms per liter were usually in the parts-per-billion or sub parts-per-billion range; thus the release of such low levels of most soluble trace metals from land disposal areas should create negligible impact on receiving waters.

4. The oil and grease fraction was not found to have an exceptional affinity for chlorinated hydrocarbons (e.g., DDT analogs and PCBs) or for trace metals. Although contaminants are not contained in the oil and grease fraction per se, high levels of effluent oil and grease may subsequently entrain contaminated settleable solids.

5. The findings of this report, in conjunction with the findings of other related studies, strongly indicate that land disposal of dredged material should not impact the environment if settleable solids are removed before effluent discharge. However, during this field study, low dissolved oxygen levels, as well as solid-phase concentrations of oil and grease, some chlorinated hydrocarbons, and total phosphorus, were occasionally observed in effluents (especially at Pinto Island, where effluent suspended solids were highest). Soluble phosphorus was usually at very low levels in effluent samples.

6. The data in this report are applicable for defining pollution problems associated with confined land disposal of dredged material. The specific physical, chemical, and geochemical tests performed and discussed herein should be used in conjunction with site-specific findings for developing mitigative measures should water-quality degradation be suspected at a particular site. The results should aid those persons concerned with the permit programs, writing of Environmental Impact Statements, or designing effluent monitoring programs or studies.

John L. Cannon

JOHN L. CANNON
Colonel, Corps of Engineers
Commander and Director

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Influents	Waste disposal sites
Particulates	Water quality

MICROMETERS

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A detailed analysis of contaminants in influents and effluents from two confined dredged material disposal areas is presented. The sites are located at Pinto Island, Mobile Bay, Alabama, and Grassy Island, Detroit, Michigan.

The samples were separated into 0.05-μ, 0.45-μ, and 8.0-μ fractions. The total sample and filtrate were analyzed for metals, nutrients, total carbon, organic carbon, chlorinated hydrocarbons, oil and grease, sulfide, and solids content. The total solids were subjected to a geochemical partitioning scheme to determine changes of metal solid phases during confined area disposal. The oil and grease fractions in the samples were analyzed for trace metals. A 48-hour settling test was performed to quantify the CONT

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20. ABSTRACT (Continued).

CONT

migration of soil and grease and chlorinated hydrocarbons during resedimentation of dredged material within a confined area.

A statistical analysis of the data was performed to determine the significance of variance in terms of pollutant loading between influent and background water; influent and effluent in terms of removal efficiency; and effluent and background water in terms of potential water quality impact. Tests for significance at the 95 and 99 percent confidence levels are presented.

The results show that, in general, the removal efficiency of total trace metals was very similar to the total solids removal. These results are in agreement with the analytical data which show that approximately 99% of the total trace metals was associated with the solid settleable phase (> 8-μ).

MICROMETERS

The results of the particle size study show that most of the other constituents in the influent and effluent samples were associated with settleable particulates. Only a very small portion was in the soluble (< 0.05-μ) phase and in the medium-size (0.05-μ to 8-μ) fraction. A few species exhibited a different particle size fractionation. Significant quantities of sodium, calcium, magnesium, potassium, NH_3-N, total carbon, and organic carbon were in the soluble phase; hence, the removal efficiency of these constituents was low in comparison with the removal of total solids. Soluble phosphate and sulfide were below detection limits.

The results of the geochemical phase partitioning show that the concentration of most metals (As, Cr, Mn, Ni, Pb, and V) remained unchanged in both the exchangeable and carbonate phase extractions of influent and effluent samples. Zinc showed noticeable increases and iron showed decreases in both of the above phases during land containment; cadmium and copper also showed increases in the exchangeable phase extractions.

The nearly complete removal of chlorinated hydrocarbons during the settling tests indicates that the association of chlorinated hydrocarbons with the oil and grease fraction is not a significant factor. The data also show that the concentration of trace metals associated with the release of oil and grease is negligible in comparison with the total sample concentration.

The concentrations of soluble trace metals in the effluents at both sites were in the ppb or sub-ppb range. These values are well below marine water quality criteria; therefore, the water quality impact of the more readily available soluble trace metals discharged into the receiving waters is considered to be negligible.

Marine water quality criteria are based on total concentrations. The results of this study show that the total trace metal concentrations in the effluents at both disposal sites were significantly greater than the marine water quality requirements. Therefore, confined disposal operations will require either long detention times or treatment in order to meet applicable water quality standards. On the other hand, it may be necessary to amend appropriate water quality criteria to differentiate the ecological significance of soluble and particulate fractions so that meaningful water quality criteria can be established.

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PREFACE

This report represents an extension of a study concerning the characterization of influents, effluents, and surface background waters in the disposal of dredged material in confined areas. It was conducted as part of the Corps of Engineers' Dredged Material Research Program (DMRP) under work unit 2D04 entitled, "Characterization of Confined Disposal Area Influent and Effluent Particulate and Petroleum Fractions," Environmental Impacts and Criteria Development Project (EICDP).

This study was conducted during the period of October 1976 - September 1977 by the Environmental Engineering Program at the University of Southern California, Los Angeles, CA. Sample collection and field data were performed by the U. S. Army Engineer Waterways Experiment Station (WES), Vicksburg, MS. The study was under supervision of Dr. Kenneth Y. Chen, Director, Environmental Engineering Program, at U.S.C. Dr. James C. S. Lu was responsible for the overall coordination and supervision of laboratory operation. M. Knezevic and B. Eichenberger assisted in the statistical analysis of data as well as preparation of the final report.

The collection of field samples, field measurements and site surveys were primarily conducted by Mr. Ronald E. Hoeppel, who was also the contract manager for this work unit.

The contract was monitored by Mr. Hoeppel under the direct supervision of Dr. Robert M. Engler, Project Manager of the EICDP, and the general supervision of Dr. John Harrison, Chief, Environmental Laboratory, WES.

Contracting Officer was Mr. A. J. Breithaupt. Directors of WES during the conduct of this study were COL G. H. Hilt, CE, and COL J. L. Cannon, CE. Technical Director was Mr. F. R. Brown.

CONVERSION FACTORS, U. S. CUSTOMARY TO METRIC (SI)
UNITS OF MEASUREMENT

U. S. customary units of measurement used in this report can be converted to metric (SI) units as follows:

Multiply	By	To Obtain
inches	25.4	millimeters
feet	0.3048	meters
acres	4046.856	square meters
cubic yards	0.765549	cubic meters
gallons (U.S. liquid)	3.785412	liters
gallons (U.S. liquid) per minute	3.785412	liters per minute
pounds (force) per square inch	6.894757	kilopascals
electron volts	1.60219×10^{-19}	joules

CONTENTS

CHARACTERIZATION OF CONFINED DISPOSAL AREA INFLUENT AND EFFLUENT PARTICULATE AND PETROLEUM FRACTIONS

PART I: INTRODUCTION

1. Both particulate and petroleum fractions in dredged material suspensions from confined disposal areas have potential pollutional effects on the receiving waters. In the literature, there exists considerable data on sediment size fractions as well as the oil and grease content in sediments. However, information is lacking on the size fractionation of the contaminants in dredged material and the concentration of toxic materials associated with the oil and grease fraction after sediments are suspended.

2. Particle size distribution is important in evaluating the pollution potential of dredged sediment. A few factors to be considered are: (a) suspended solids or slow settling solids contribute to turbidity, (b) suspended solids reduce the penetration of light, hence affecting photosynthetic activity, (c) suspended solids may have a deleterious effect upon filter-feeding organisms, and (d) small particles usually contain larger specific surface areas and require longer retention times for removal. These slower settling particulates may cause degradation of receiving waters if not properly removed.

3. The petroleum fraction of the dredged material may be an important parameter because of its ability to easily separate from the particles and disperse into and float on the receiving waters. Also, the petroleum fraction can be associated with toxic pollutants such as trace metals.[1]

4. In view of the potential problems as previously discussed, the characteristics of influent and effluent particulates and petroleum fractions become very significant.

It is important not only to assess the particle size distribution and the oil and grease contents in the sediments and water columns, but also to evaluate the amount of pollutants associated with different particulates and oil and grease fractions. A detailed analysis was made on influents and effluents from two confined dredged material disposal areas: Pinto Island, Mobile Bay, Alabama, and Grassy Island, Detroit, Michigan.

5. The collected background water, influent, and effluent samples were separated into the following fractions: (a) total sample, (b) soluble fraction (0.05-μ filtrate), and (c) medium-size particulates (between 0.45- and 8-μ). Each fraction was analyzed for metals, nutrients, total carbon, total organic carbon, chlorinated hydrocarbons, oil and grease, sulfide, and solids content. In addition, the 0.45-μ filtrate was also analyzed for chloride, alkalinity, conductivity, and salinity. The total solids were also subjected to an elemental partitioning scheme for determining changes of metal solid phases during confined area disposal.

6. The oil and grease fractions for samples from these two sites were analyzed for metal content. A 48-hour settling study was also performed for quantifying the transport property of oil and grease and chlorinated hydrocarbons during resedimentation of dredged material.

PART II: EXPERIMENTAL PROGRAM

7. Two active disposal sites were selected for in-depth characterization of influent, effluent and background water. The selection of these two sites was based on preliminary data obtained in a previous study carried out by U.S. Army Engineer Waterways Experiment Station (WES) on "Physical and Chemical Characterization of Contaminated Dredged Material Influents and Effluents in Confined Land Disposal Areas."[2]

Site Description and Dredging Operations

Pinto Island Disposal Site, Mobile Bay, Alabama (Figure 1)

8. Size of diked area. 65 acres; 40 acres ponded.*

9. Dredging site. Marine Bulk Ore Handling Slip on the west side of the Mobile River Ship Channel. Dredged material was transported by direct pipeline to the disposal area.

10. Time period of dredging/disposal operations. 3 Sept. (10:20 PM) to 10 Sept. (9:00 PM) 1976.

11. Sample collection. 7,8 Sept. 1976

12. Total in situ sediment volume dredged from slip (3-10 Sept. 1976). 51,814 cu. yds.

13. Daily in situ sediment volumes dredged. 7 Sept. 1976, 12,045 cu. yds; 8 Sept. 1976, 9,450 cu. yds. No data are available for effluent volumes.

14. Vegetation. About 15 to 20% of the northern section of the disposal area was covered with a moderate growth of vegetation identified as primarily *Phragmites communis* and other salt tolerant bushy plants (see Appendix A).

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* A table of factors for converting U.S. customary units of measurement to metric (SI) units is presented on page iii.

15. <u>Weather at disposal area</u>. 7 Sept. 1976, about 3/4-inch rain, 4:00-5:00 PM; 8 Sept. 1976, about 3/4-inch rain, 6:30-8:30 AM.

Note: Effluent samples were collected on 8 Sept. 1976 after a total rainfall of approximately 1-1/2-inches; the dilution factor must be considered in the evaluation of parameter concentrations.

16. Surface background water samples were taken outside of the effluent mixing zone at the southern end of the disposal area at the confluence of the Mobile River and Mobile Bay.

17. The salinity of surface background water at the Pinto Island site was 3 o/oo. Dredged sediments from the dredging site were quite reducing, with substantial quantities of sulfides. Field studies of influent slurries from Pinto Island show a large immediate oxygen demand. The level of dissolved oxygen for this influent slurry was between 0.5 and 0.6 mg/l in the mixing pool beneath the influent discharge pipe.

<u>Grassy Island Disposal Site, Detroit, Michigan (Figure 2)</u>

18. The diked disposal facility on Grassy Island in the Detroit River was brought to its present dimensions in 1969 for the containment of polluted maintenance dredged material, primarily from the Rouge River in Detroit.

19. Subsequently, a cross dike was constructed dividing the disposal site into a north and south area. During the study only the north half of the disposal area was used with the influent pipe entering the southwest corner; effluent was discharged over a weir in the northeast corner.

20. EPA's 1973 sediment sampling indicated that the Rouge River was very heavily contaminated with many common industrial and municipal pollutants. Parameters to be tested for at the Grassy Island discharge were selected based on EPA's testing.

21. Size of diked north area. 30 acres; 10 acres ponded

22. Dredging site. Main channel of Rouge River.

23. Time period of dredging/disposal operations. 3 Aug. 1976 to 16 Sept. 1976.

24. Sample collection. 24, 25, 26, Aug. 1976

25. Total in situ sediment volume dredged from channel (3 Aug. - 16 Sept. 1976). 113,335 cu. yds. Dredging was performed with a hopper dredge; pump out time was approximately 45 minutes for each hopper load, with about a 2-1/2-hour dredging and hopper dredge transit time.

	24 Aug.	25 Aug.	26 Aug.
No. of hopper loads/day	8	8	7
Total in situ sediment volume in hopper bin, cu.yds.	3464	3422	3254
24-hour average influent volume,gpm	1950	1920	1825

No data are available for effluent volumes.

26. Vegetation. Dominant vegetation at Grassy Island was *Phragmites communis*.

27. Background water samples were taken from the Rouge River at about the same location as the dredging operations. The salinity of background water at the Grassy Island site was negligible (0.2 o/oo). Dredged sediments from the dredging site are quite reducing, with substantial quantities of sulfides. The level of dissolved oxygen in the influent slurry ranged from 7.1 to 7.6 mg/l.

Analyses of Samples

28. Samples from the dredged material disposal sites

were divided into three groups: (a) background water, (b) influent slurry, (c) effluent slurry.

29. All samples were collected by personnel of the Corps of Engineers at WES and preserved by packing them in ice upon collection and during transportation to the University of Southern California (USC) laboratory. Samples were then stored in an environmental chamber at $4^{O}C$ until used. Chloroform was added in the field for the preservation of samples for nitrogen and phosphorus analyses. Samples for the analysis of chlorinated hydrocarbons were stored in Pyrex (glass) containers. Other samples were stored in polyethylen (plastic) containers. A detailed description of the collected samples is listed in Table 1.

30. All samples were separated into the following four fractions by successive filtrations:

- a. Total sample - this was prepared by homogeneously mixing the original sample followed by withdrawal of a desirable amount by plastic syringe or plastic automatic pipet.
- b. 8-μ filtrate - 8-μ filtrate sample was prepared by passing the homogenized sample through an 8-μ millipore membrane filter (SC nitrocellulose type) by pressurized filtration.
- c. 0.45-μ filtrate - 0.45-μ prepared by pressurized filtration through a 0.45-μ millipore membrane filter (HA nitrocellulose type).
- d. 0.05-μ filtrate - 0.05-μ was prepared the same way as the 8-μ and 0.45-μ filtrates. A 0.05-μ millipore membrane filter (VM nitrocellulose type) was used.

31. Settling tests were performed to determine the fates of oil and grease and chlorinated hydrocarbons and their interrelations in the water column after disposal. One liter of total sample was placed in a standard 1-liter cylinder and then shaken for 1 minute. The supernatants were withdrawn by a syringe at different time periods (2 hrs, 12 hrs, 24 hrs, and 48 hrs) from separate cylinders.

Analytical Parameters

32. Tests of physical and chemical properties were performed on all samples. The important environmental parameters analyzed are outlined as follows:

33. Total sample

a. nitrogen (total Kjeldahl, NH_3-N)

b. Phosphorus (total)

c. carbon (total, organic)

d. dry weight

e. oil and grease

f. acid soluble sulfide

g. cation exchange capacity

h. chlorinated hydrocarbons

i. metals (Ca, Mg, Na, K, Cd, Cu, Fe, Hg, Mn, Ni, Pb, Se, Ti,V, and Zn) - on both acid soluble samples as well as metals in oil and grease.

j. exchangeable metals

k. metals associated with carbonate phase

l. particle size distribution

m. hydrocarbons

34. 8-μ filtrates

a. nitrogen (total Kjeldahl, NH_3-N)

b. phosphorus (total, ortho-)

c. sulfide (soluble)

d. carbon (total, organic)

35. 0.45-μ filtrates

a. nitrogen (total Kjeldahl, NH_3-N, NO_2-N, NO_3-N)

b. phosphorus (total, ortho-)

c. sulfide (soluble)

d. carbon (total, organic)

e. salinity

f. conductivity

g. pH

h. alkalinity

i. chloride

j. metals (Ca, Mg, Na, K, Cd, Cu, Fe, Hg, Mn, Ni, Pb, Se, Ti, V, and Zn)

36. 0.05-μ filtrates

a. nitrogen (total Kjeldahl, NH_3-N, NO_2-N, NO_3-N)

b. phosphorus (total, ortho-)

c. sulfide (soluble)

d. carbon (total, organic)

e. metals (Ca, Mg, Na, K, Cd, Cu, Fe, Hg, Mn, Ni, Pb, Se, Ti, V, and Zn)

37. When sediments are resuspended in a confined disposal area, oil and grease may be released and later discharged into the receiving waters. During this process, trace metals and chlorinated hydrocarbons may also be mobilized in association with the oil and grease fraction. Therefore, the oil and grease extracts from total influent and effluent samples were also used for the determination of trace metals. Chlorinated hydrocarbons were analyzed in the surface layer (about 2-3 inches) below the surface of water samples after settling.

38. Oil and grease samples were also characterized with a gas chromatography-mass spectrometry (GC-MS) system for the identification and quantification of major hydrocarbons including aromatic, straight chain and branched aliphatics. These analyses were performed on some representative samples only.

Analytical Methods

39. The measurements of pH, nitrogenous compounds, total and organic carbon (TC and TOC), alkalinity, conduc-

tivity, sulfide, and chloride follow the methods described in Standard Methods.[3] The procedures and instruments used in this study are listed as follows:

	Parameter	Method
a.	pH	Potentiometric (Orion 601A and 801A)
b.	NH_3-N	Acidimetric method
c.	NO_3-N	Brucine method (Perkin-Elmer 124, light path 10 cm, 410 nm)
d.	NO_2-N	Photometric method (Perkin-Elmer 124, light path 10 cm, 543 nm)
e.	Organic-N	Kjeldahl method
f.	TC and TOC	Combustion-infrared method (Beckman 915)
g.	Alkalinity	Potentiometric titration (Orion 601A and 801A)
h.	Conductivity	Conductivity meter (Barnstead PM-70CB) YSI Model 33 salinity conductivity-temperature meter (used in field)
i.	Chloride	Mercuric nitrate method
j.	Sulfide (soluble)	Titrimetric (iodine) method
k.	Cation exchange capacity	Sodium saturation method
l.	Exchangeable metals	Ammonium acetate extractable[4]
m.	Metals (carbonate phase)	Acetic acid extractable[4]

n.	Salinity	Refractometer (American Optical Corp. Goldberg T/C, Model 10419) YSI Model 33 salinity, conductivity-temperature meter (used in the field)
o.	Metals (total filtrates, hexane extracts)	Perkin-Elmer atomic absorption spectrophotometers. Models 305B and 460 (Appendix B)
p.	Acid soluble sulfide	Titrimetric method[4] (Appendix B)
q.	Phosphorus (total, ortho-)	Modified ascorbic acid method (Appendix B)
r.	Chlorinated hydrocarbons	Gas chromatography (Appendix B)
s.	Petroleum hydrocarbons	GC-MS (Appendix B)
t.	Dissolved oxygen	YSI Model 57 Dissolved oxygen meter

PART III: RESULTS

40. The following results are, for the most part, based on the statistical analysis of the influent, effluent, and background water data. In some cases, when only one sample was analyzed, the determination of statistical significance (F-test) is not possible. In such circumstances, sound scientific judgement was applied in the interpretation of the analytical data. Time limitations did not permit the determination of statistical significance of variance between particulate fractions. The following F-tests for significance at the 95 and 99 percent confidence levels ($P \leq 0.05$, $P \leq 0.01$) are presented in Tables 2 and 3.

a. Influent vs. background water (pollutant loading)

b. Influent vs. effluent (removal efficiency)

c. Effluent vs. background water (potential water quality impact)

41. It should be noted that surface background water samples were collected at the Grassy Island dredging site and outside the mixing zone at the Pinto Island disposal area. Ideally, background water samples should have also been collected at the dredging and disposal sites for both Grassy Island and Pinto Island. This was not done because of time restrictions and collection problems.

Increase of Pollutant Loading During Dredging

General parameters (background water, influent)

42. Field data for the Pinto Island and Grassy Island disposal sites are given in Table 4. Average values for physical and chemical parameters of influent and background water samples are given in Table 5. From the results, it can be seen that the background water concentrations of most parameters were lower than those of the dredged material influent slurries at both disposal sites.

43. The average total solids in the Pinto Island influent samples were increased from the background level of 0.46% to about 7% (Table 3). This indicates that, during the dredging operation, the mixing weight ratio of dredge site water to bottom sediment ranged from 7 to 10 (based on a harbor bottom sediment moisture content of 30 to 50%).

44. For the Grassy Island samples, the total solids content increased from 0.01% to about 19%, indicated a 1.5 to 2.5 mixing weight ratio. These results indicate that there was better dredging efficiency at the Rouge River dredge site although the higher solids contents may have been obtained by allowing hopper overflow.

45. The change in salinity after mixing was negligible in the Grassy Island samples; however, salinity was about 8.5 times higher in the Pinto Island influent samples than in background water, with average influent and background water values of 25.5 o/oo and 3 o/oo, respectively. However, since surface water was obtained for a background water sample, much of the salinity increase may have been caused by higher salinity in bottom water at the dredging site; the Mobile River at the dredge site displays salinity stratification.

46. For Pinto Island samples, conductivity was about 5 times higher (from about 5 mMhos to 25 mMhos) in the influent samples. For Grassy Island samples, the conductivity was about 3 times greater (from about 0.04 mMhos to 0.11 mMhos). Again, it should be noted that surface background water samples were taken; the dredged bottom water at the Pinto Island site may have had a higher salinity than the surface water, which would contribute to the observed increases in influent conductivity.

47. The alkalinity measurements (as $CaCO_3$) after sediment-water mixing show an increasing trend at both sites. The alkalinity at Pinto Island was at about 50 mg/l in the surface background water and about 150 mg/l in an

average effluent. Grassy Island alkalinity increased from 130 mg/l to about 500 mg/l.

48. The percent increase of chloride concentration was close to the increase of conductivity, indicating that soluble chloride salts probably account for most of the conductivity changes.

Total carbon (TC) and total organic carbon (TOC)

49. The TC and TOC measurements were obtained for different size fractions as well as total slurry samples (see Tables 5 and 6). The average TC and TOC concentrations in different filtrates (8-μ, 0.45-μ, and 0.05-μ) show similar concentrations in filtrates passing through all filter sizes. Thus, the data show that the TC and TOC are primarily in the 0.05-μ filterable phase for sample particles less than 8-μ.

50. The fraction of total carbon in the 0.05-μ filtrates was 64% and 61%, respectively, for Pinto Island and Grassy Island influent samples. Total organic carbon in the 0.05-μ influent filtrates was 53% for Pinto Island and 30% for Grassy Island.

51. The total filterable carbon concentration (0.05-μ filtrate) was lower in the background water by 3 and 4.5 times, respectively, for both the Pinto and Grassy Island sites. Similarly, the total filterable organic carbon (0.05-μ filtrate) increased about 3 and 6 times in Pinto and Grassy Island influents, respectively.

52. The total inorganic carbon (TIC=TC-TOC) data can be derived from Table 5. Figure 3 shows the relationship between alkalinity and TIC. The data fit quite well around a straight line with a slope of 5. This indicates that alkalinity is mostly comprised of bicarbonate ions:

$$\frac{C_{HCO_3^-}}{C_{TIC}} = \frac{61}{12} \approx 5.$$

Nutrients

53. The results of the nutrient analyses are given in Tables 5 and 6. The sum of the nitrogen compounds (NH_3-N + organic N + NO_2-N + NO_3-N) increased significantly in the influent slurries; the contribution of NO_3-N and NO_2-N was negligible for both sites. In the influent samples, the total nitrogen increase was about 40 times (from 1 mg/l as N to 40 mg/l as N) for Pinto Island samples and 145 times (from about 1 mg/l as N to 145 mg/l as N) for Grassy Island samples. For Pinto Island, the increase of total nitrogen contributed by NH_3-N and organic N was 25% and 75%, respectively. For Grassy Island, the increase due to NH_3-N was 58% and 42% for organic N. The use of the NH_3-N notation is one of convention. In this study, NH_4^+-N is the dominant species, i.e., pH <9.3.

54. The soluble (< 0.05-μ) phosphorus concentrations in both the influent and background water samples were negligible at both sites. The increase in total phosphorus concentrations at Pinto Island and Grassy Island was due entirely to the solid phase (> 8-μ) as shown in Tables 5 and 6.

Metals

55. Tables 5 and 6 present the data for metal release at both sites. These results show that the trace metal concentrations in both the solid and soluble phases were higher in the influent slurries than in the background water samples, with the exception of soluble zinc (0.05-μ) at Pinto Island. The factors of increase for soluble metals (< 0.05-μ) are as follows (minus sign indicates a scavenger effect):

	Cd	Cu	Fe	Hg	Mn	Ni	Pb	Se	Ti	V	Zn
Pinto Island	4	2	85	7	>5	2	5	9	>5	>7	-3
Grassy Island	40	4	20	3	38	6	5	>1	>2	>3	50

56. Four metal species, Cd, Fe, Mn, and Zn, were found to be strongly released (with factors greater than 10) from Grassy Island dredged material while high concentrations of soluble Fe were released from Pinto Island sediments; comparisons were made with the background water values.

57. The increase of total metal concentrations in the influent samples was mainly associated with the total solid phase. The factors of increase based on total concentrations are listed as follows:

	Cd	Cu	Fe	Hg	Mn	Ni
Pinto Island	37	6	> 2300	>34	20	460
Grassy Island	340	83	190,000	85	>26	2900

	Pb	Se	Ti	V	Zn
Pinto Island	12	>3	>5	>4	15
Grassy Island	260	620	>8	1800	105

58. Samples from Grassy Island show greater increases in total metal concentrations mainly due to the higher solids content of the influent samples.

Oil and grease

59. The total oil and grease concentrations in influent and background water samples are given in Table 5. The ratios of increase for total oil and grease was 130 for Pinto Island and 160 for Grassy Island, indicating that the in situ sediments were the major source for the oil and grease fractions.

Chlorinated hydrocarbons

60. Table 5 shows that the release of chlorinated hydrocarbons from the solid phase to the water column was negligible (for details, see the Settling Study section). The increase of chlorinated hydrocarbons in the influent samples was mainly associated with the solid phase. The ratios of increase for total DDT and total PCB are:

	Total DDT	Total PCB
Pinto Island	220	> 1400
Grassy Island	350	380

Petroleum hydrocarbons

61. Table 7 shows the total concentrations of selected petroleum hydrocarbons in influent and background water samples. The increase of petroleum hydrocarbons was negligible with the exception of total alkanes where the ratios of increase were > 6 for both Pinto Island and Grassy Island samples.

Removal Efficiency of Disposal Sites

62. The effectiveness of the disposal sites in removing the suspended and soluble constituents is affected by a combination of many factors, e.g., topography, geology, weather conditions, effective area, volume, depth of the disposal site, detention time, and flow rate, as well as the physical and chemical properties of dredged material and entrained waters (redox condition, particle size distribution, salinity, etc.). Due to the complexity of conditions at the disposal site and the variability of the influent samples, the removal mechanisms are usually difficult to predict and explain. The best way to judge the effectiveness of the disposal site is from the analytical results of both influent and effluent samples.

General parameters

63. The analytical results of some general water quality parameters of influent and effluent samples are listed in Table 5. Parameters such as pH, salinity, conductivity, and chloride show slight to moderate changes between influent and effluent samples. The average percent changes are as follows (minus sign indicates that the para-

meter was decreased in the influent); values within parentheses are not statistically significant (see Tables 2 and 3).

	pH	Salinity	Conductivity	Chloride
Pinto Island	(5.4)	(-19.2)	-11.3	(-14.0)
Grassy Island	(0)	*	-38.9	-5.9

* trace concentration

64. The Pinto Island disposal site showed approximately a 46% removal of the total solids. However, there was almost complete removal of the total solids for the Grassy Island disposal area, i.e., 99.7%. The high total solids removal at Grassy Island was due to long detention times obtained by total confinement procedures, i.e., negligible discharge of effluent to the receiving waters.

65. The decrease in alkalinity at Grassy Island was about 50%. This reduction could be the result of pH increase caused by the uptake of carbon dioxide during photosynthesis and the subsequent precipitation of calcium carbonate. Photosynthetic activity is indicated by the presence of planktonic algae in sufficient number to give the effluent a greenish color. The increase in alkalinity at Pinto Island was not significant. Significant, as used within the context of this study, refers to statistically significant differences.

66. The cation exchange capacity decreased 58% for the Pinto Island samples. Due to the very low solid content in the Grassy Island effluent, the cation exchange capacity could not be determined.

67. The soluble (< 0.05-μ) sulfide was determined for both sites; however, all of the samples showed only trace amounts of sulfide in the soluble phase. This may be due to the oxidation of sulfide species during sample transportation. Therefore, the results for soluble sulfide probably do not represent the actual field situation.

68. Results show that the total acid soluble sulfide was decreased at both sites during disposal activities. In the Pinto Island samples, the decrease was from about 20 mg/l to about 3 mg/l (Table 5). In the Grassy Island samples, the decrease was from about 38 mg/l to about 0.15 mg/l. It is believed that these decreases were due to both the removal of suspended solids and the oxidation of sulfide solids. In the Pinto Island samples, the 46% decrease in solids content can only account for approximately one-half of the decrease of total acid soluble sulfide, since the experimental results showed about an 83% decrease. This indicates that approximately 37% of the metals originally associated with the sulfide solids were changed to other species due to oxidation.

69. The percent removal of total acid soluble sulfide in the solid phase versus the quantity oxidized to other species is only an approximation. Since the particle size distribution of total acid soluble sulfide was not determined, its association or removal efficiency from different particle size fractions is not known. The 99.6% removal of total acid soluble sulfide at Grassy Island is in excellent agreement with the 99.7% removal of total solids.

Total carbon and total organic carbon

70. Data for total carbon and total organic carbon are listed in Tables 5 and 6. Total carbon in the Pinto Island effluent samples increased by 59%; the observed increases in the particulate size fractions were not significant. Total carbon in the Grassy Island effluent decreased by 55%. The following reductions were observed for the Grassy Island particulate fractions: 59% (8-μ); 58% (0.45-μ); 55% (0.05-μ).

71. The 111% increase of total organic carbon in the Pinto Island effluent samples was probably due to photosynthetic processes and subsequent vegetation decomposition.

Total organic carbon in the Grassy Island effluent decreased by 62%. This decrease was probably due to both the removal of suspended solids and the oxidation of soluble organic carbon. The percent oxidation of organic carbon cannot be determined because the results do not indicate a significant difference between influent and effluent samples.

Nutrients

72. Nutrient data are listed in Tables 5 and 6. No interpretation of the Pinto Island data is possible because the differences are either not significant or indeterminate. The average removal efficiencies of NH_3-N and organic N in the total slurry samples were 83% and 96%, respectively, at the Grassy Island site. The removal of (< 0.45-μ) NO_3-N was not significant; the removal of (< 0.45-μ) NO_2-N was indeterminate. The removal of soluble (< 0.05-μ) NH_3-N and organic N was also indeterminate.

73. Theoretically, in the oxidizing environment, the observed decrease in total NH_3-N and organic N at Grassy Island would indicate an increase in the nitrate level. The data do not show a significant increase of NO_3-N, probably as a result of denitrification in the anaerobic disposal area sediments or by biological uptake. Biological uptake is most plausible at Grassy Island, as the site contained abundant vegetation and algae in the water column.

74. Total phosphorus removal was 99.9% at Grassy Island; removal at Pinto Island was not significant. Phosphorus compounds in the soluble phase (< 0.05-μ) were below detection limits in influents and effluents from both sites. The absence of measurable influent soluble phase phosphorus indicates that the phosphorus compounds were strongly associated with the particulates and could not be released during dredging activities or rapid chemical scavenging occurred in the influent slurry. The low effluent values may result from the formation of $FePO_4$ precipitates; also,

biological uptake could maintain low soluble phosphorus (orthophosphate) concentrations in the disposal area.

Metals

75. Tables 5 and 6 give the results of metal concentrations in influents and effluents. The average percent removal efficiencies of major ions (Na, K, Ca, and Mg) in the total samples are as follows:

	Na	K	Ca	Mg
Pinto Island	--	54	(23)	--
Grassy Island	--	61	(44)	10

76. The percent removal of major ions in the total samples was less than the percent removal of total solids, with the exception of potassium at Pinto Island. These results are reasonable when considering the particle size distribution of the ions, and the total solids removal, e.g., 89% of the potassium in the Pinto Island influent was in the settleable fraction (> 8-μ) compared with a total solids removal of 46%. Conversely, 41% of the magnesium in the Grassy Island influent was in the soluble (< 0.05-μ) phase compared with a total solids removal of 99.7%.

77. The percent removal of the soluble phase (< 0.05-μ) major ions (Na, K, Ca, Mg) was not significant at either site with the exception of 54% removal of magnesium at Grassy Island.

78. The average removal efficiencies of trace metals in the total samples are as follows:

	Cd	Cu	Fe	Hg	Mn	Ni	Pb	Se	Ti	V	Zn
Pinto Island	18	52	46	35	54	67	35	39	48	45	35
Grassy Island	~100	93	99	96	(98)	95	(99)	(97)	97	(96)	98

79. Comparing these results with those of total solids removal (46% for Pinto Island and 99.7% for Grassy Island), it appears that the removal efficiencies of metals in the total samples were very similar to the total solids removal

with the exception of cadmium and nickel at the Pinto Island site. This is quite reasonable since the majority of the trace metal concentrations are associated with the solid phase (see Tables 5 and 6). The weight percent of trace metals in the particulate phase (> 8-μ) was at least 99% for all of the influent samples with the exception of 97% for cadmium at Pinto Island.

80. Among the metals determined, the removal efficiency of cadmium in the Pinto Island site was far below the removal of total solids. On the other hand, the removal efficiency of nickel in the Pinto Island site was far above that of the total solids. This was probably caused by the separation of particles during resettling. In the former case, cadmium probably existed primarily in smaller particles, so that after resettling, more cadmium solids remained in suspension. However, the nickel in the Pinto Island samples might be associated more predominately with larger particles which could account for the increased percent removal.

81. The percent removal efficiencies of soluble trace metals (0.05-μ filtrate) are as follows (plus sign indicates that the concentration was increased in the effluent sample):

	Cd	Cu	Fe	Hg	Mn	Ni
Pinto Island	26	(+45)	86	(23)	24	(13)
Grassy Island	81	(54)	95	(0)	(36)	(12)

	Pb	Se	Ti	V	Zn
Pinto Island	(30)	(46)	(36)	(42)	(+250)
Grassy Island	(+15)	(68)	(5)	(27)	98

The data show no significant differences for Cu, Hg, Ni, Pb, Se, Ti, and V at both sites; for Zn at Pinto Island; and for Mn at Grassy Island. The removal of iron at both sites, and cadmium and zinc at Grassy Island was quite effective. The soluble concentration levels of trace metals

in the effluents were less than 15 μg/l with the exception of manganese at Grassy Island which had a value of 49 μg/l.

Oil and grease

82. The oil and grease content in the total samples (solution plus solid phase) decreased after confinement (Table 5.) The removal efficiencies were 90% and 99.7 % for the Pinto Island and Grassy Island sites, respectively. The removal efficiency at the Grassy Island site was very close to that of the total solids removal. However, the removal efficiency at the Pinto Island site was much greater than the total solids removal, i.e., 90% vs. 46%.

Chlorinated hydrocarbons

83. The results for chlorinated hydrocarbons are given in Table 5. Among the chlorinated hydrocarbon species, only DDD, DDE, DDT, and PCB compounds were detected. The percent removal efficiencies of chlorinated hydrocarbons in the total samples are:

	op'DDD	pp'DDD	op'DDE	pp'DDE
Pinto Island	(59)	70	75	75
Grassy Island	99.0	99.6	96.7	99.4

	op'DDT	pp'DDT	Total DDT
Pinto Island	100	100	80
Grassy Island	99.2	99.4	99.5

	Aroclor 1242	Aroclor 1254	Aroclor 1260	Total PCB
Pinto Island	96	97	99	96.5
Grassy Island	98.9	99.8	99.8	99.1

84. For the Grassy Island site, the removal of chlorinated hydrocarbons by confinement was very close to the total solids removal. For the Pinto Island site, the removal of chlorinated hydrocarbons was much higher than the total solids removal; this result could be due to the fact that

chlorinated hydrocarbons were associated with large particles. The 59% removal of op'DDD at Pinto Island was not significant.

Settling Study

85. The purposes of the settling tests were:

   a. To observe the general transport phenomena during resedimentation in confined disposal areas.

   b. To determine the relationships between particle size and the concentration of chemical constituents.

   c. To investigate the possibility of concentrating trace metals and chlorinated hydrocarbons in the oil and grease fraction.

86. Results of the settling tests are given in Table 5 and Figures 4 to 29.

Transport of oil and grease during resettling

87. The data for oil and grease release during resettling are shown in Table 5, and Figures 4 to 7. The results show that during the resettling of the influent dredged material, some oil and grease from the solid phase was being continuously released into the solution phase within the first 24 hours. The solution phase oil and grease concentration usually increased slowly after 24 hours if the value at 24 hours was low. The data also show a rapid removal after 24 hours if the value at 24 hours was high. After a careful check of the settling equipment, it appears that the subsequent removal was not due to readsorption by the sediment particles. It is speculated that for high oil and grease levels in the solution phase, the excess tends to flow to the surface and accumulates on the wall of the settling column, thus decreasing the oil and grease content within the water column. Similar removal could occur through contact of the slurry with vegetation or other solid surfaces within the disposal area.

Transport of chlorinated hydrocarbons during resettling

88. The results of the settling tests for chlorinated hydrocarbons are given in Table 5 and also Figures 8 to 29. The data show that the chlorinated hydrocarbons were removed rapidly during dredged material resettling. Most of the chlorinated hydrocarbons were resettled within the first 2 hours. Below is a list of the percent removal efficiencies of different chlorinated hydrocarbons in the influent samples within two hours of settling:

	op'DDD	pp'DDD	op'DDE	pp'DDE
Pinto Island	80.9	77.9	74.1	55.2
Grassy Island	77.2	77.3	77.3	56.5

	op'DDT	pp'DDT	Total DDT
Pinto Island	34.9	34.7	56.3
Grassy Island	33.6	57.1	66.2

	Aroclor 1242	Aroclor 1254	Aroclor 1260	Total PCB
Pinto Island	60.7	83.5	75.9	76.6
Grassy Island	75.3	84.6	83.7	77.8

89. Among the chlorinated hydrocarbons, op'DDD, pp'DDD, op'DDE, and PCB's had the highest removal rates.

90. After 48 hours of resettling, all of the chlorinated hydrocarbons were removed to very low levels. This implies that the chlorinated hydrocarbons are strongly associated with large sediment particles and release into the solution phase should be negligible. The following table shows the percent removal efficiencies after 48 hours of resettling:

	op'DDD	pp'DDD	op'DDE	pp'DDE
Pinto Island	100	100	100	99.5
Grassy Island	99.9	99.9	99.9	99.9

	op'DDT	pp'DDT	Total DDT	
Pinto Island	97.8	99.5	99.7	
Grassy Island	99.3	99.6	99.7	
	Aroclor 1242	**Aroclor 1254**	**Aroclor 1260**	**Total PCB**
Pinto Island	100	100	100	100
Grassy Island	99.0	99.7	99.7	99.2

Association of metals and chlorinated hydrocarbons with oil and grease

91. The association of metals with oil and grease in the total samples is given in Table 5. In general, the trace metal content of the oil and grease fraction in the effluent samples is less than 5 μg/l (in terms of the original sample volume), which is usually less than 1% of the trace metals in the total sample. The data show that the concentration of trace metals associated with the release of oil and grease is negligible in comparison with the total sample concentrations.

92. The association of chlorinated hydrocarbons with the oil and grease fraction is not significant. The results of the settling tests which show nearly complete removal of chlorinated hydrocarbons from influent during resettling indicate that the association of chlorinated hydrocarbons with the oil and grease fraction is not a significant factor.

Transformation of Metal Solids During Confined Area Disposal

93. The transformation of metal solids during the disposal of dredged material in diked containment areas was analyzed by determining the association of each metal with different geochemical phases of influent and effluent solids. This was accomplished by performing selective

chemical extractions on the solid phases of each sample. Since the exchangeable and acetic acid-extractable phases are most significant,[5] these two were analyzed. Results are given in Table 5. Data for the effluent samples from Grassy Island are not available due to their very low solids content. Thus, the transformation of metal solids during confined area disposal can only be discussed for Pinto Island samples.

94. From the results, the following phenomena were observed for the exchangeable metals:

- a. Exchangeable amount increased after confined disposal - Cd, Cu, and Zn.
- b. Exchangeable amount decreased after confined disposal - Fe
- c. No significant changes - As, Cr, Mn, Ni, Pb, and V.

95. For the acetic acid-extractable phase, the following phenomena were observed:

- a. Amount increased after disposal - Zn.
- b. Amount decreased after disposal - Fe.
- c. No significant change - As, Cd, Cr, Cu, Mn, Ni, Pb, and V.

96. Among the trace metals studied, the increases in exchangeable metals are in the following order: Zn (+1790%) > Cd (+420%) > Cu (+115%). The exchangeable iron was reduced by 59% during disposal operations. The removal of exchangeable arsenic, chromium, lead, manganese, nickel, and vanadium was not significant, implying that the release of these species by ion exchange mechanisms was negligible.

97. The zinc carbonate phase (acetic acid extractable) was increased by 25% during confined area disposal. The iron carbonate phase decreased by 47%. The arsenic, cadmium,chromium,copper, manganese and nickel carbonates showed no significant changes.

PART IV: DISCUSSION

Increase of Pollutant Loading During Dredging

98. The results of this study show an increase in total solids and pollutants in dredged material influent slurries compared to background water levels. In most cases, more than 99% of the trace metals loading is associated with the solid settleable phase (> 8-μ). Changes which affect the chemical form and concentration of soluble species are very complicated. Many mechanisms may be involved in governing these changes in the soluble phase, such as geochemical phase transformations, sorption, ion-exchange, dissolution, deposition, redox reactions, coprecipitation, complexation, and diffusion from interstitial water.

99. Regarding the higher levels of salinity, conductivity, and soluble chloride observed in the Pinto Island influent samples (compared to surface background water levels) it is believed that the major cause was salinity stratification within the Mobile River at the dredging site. However, dependent on the directions of tidal flow, volume of freshwater discharge, and rate of mixing, the dilution of higher concentrations of major ions in the sediment interstitial water during dredging could also be important. Chloride closely paralleled the changes in conductivity and salinity. It is quite probable that the surface background water samples, which were collected near the effluent discharge, are not representative of the salinity of dredged bottom water.

100. The increase of major ions in the Grassy Island influent samples over the background level was less than that of the Pinto Island site. However, the Grassy Island influents had a higher alkalinity (mainly bicarbonate) indicating increased oxidation of organic carbon to carbon dioxide, which in turn reacts with the solid carbonate species to form bicarbonate ions. The data show that Grassy Island

sediments released more soluble (< 0.05-μ) organic carbon during dredging operations. This was also true for the release of nutrients.

101. Field monitoring showed that the Pinto Island influent samples, collected in the mixing pool beneath the discharge pipe, contained between 0.5 to 0.6 mg/l of dissolved oxygen. However, measurements made directly at the end of the discharge pipe showed no measureable dissolved oxygen in the slurry. Thus, slightly oxidizing conditions were present in the mixing pool, but the slurry appeared to have a high immediate oxygen demand. In contrast, the D.O. levels of the Grassy Island samples ranged from 7.1 to 7.6 mg/l in the mixing pool indicating a strong oxidizing condition. Much of this oxygenation probably occurred during the two-hour period when the dredged material was in the hoppers of the dredge. Since both sites were subjected to oxidizing conditions, the precipitation of $FePO_4$ could be favored.[6] This may explain why the phosphate release was negligible in the influent samples.

102. The release of trace metals into the dredging site water may be primarily due to the following:

- a. Diffusion from the interstitial water.
- b. Aerobic conditions change the reduced metallic sulfide solids, which are generally highly insoluble, to more soluble oxidized solids; this is also indicated by the geochemical fractionation data.
- c. Formation of soluble metal complexes due to the increase of metal ligands in the soluble phase (such as the high levels of chloride, TOC, and nitrogen compounds in the influent samples).
- d. Ion exchange.
- e. Oxidation and decomposition of organic compounds.
- f. Desorption from clay minerals or other solid species.

103. In comparing the two dredging sites, the relative release of metals from Grassy Island sediments was greater for Cd, Cu, Ni, Mn, and Zn, and less for Fe, Hg, Se, Ti, and V. As stated previously, Grassy Island sediments probably contained more carbonate species in the presence of high alkalinity and oxidizing conditions.[5] Most carbonates are moderately soluble. On the other hand, in a strongly oxidizing environment, iron can be gradually transformed to oxyhydroxide or hydroxide solids, which have a much lower solubility.

104. The release of oil and grease into the dredging site water is probably derived mainly from the physical disturbances which tend to form oil in water emulsions as well as the specific gravity difference between water and the oil and grease emulsions.

Removal Efficiency of Disposal Sites

105. The effectiveness of a disposal site in removing suspended and soluble constituents is affected by many complicated factors. The removal of particulates is controlled mainly by the retention time of the containment area, and the particle size distribution of resuspended sediments. Generally, most of the trace metals were concentrated in the larger settleable solids of the dredged material, i.e., $> 8\text{-}\mu$. Only a very small portion was found to exist in the solution phase ($< 0.05\text{-}\mu$). Therefore, if the metals were uniformly distributed within the solid phase, the removal efficiency of trace metals associated with the particulates should be close to the removal of the total solids. The removal efficiency of trace metals in the total samples was found to be very similar to the total solids removal with the exception of cadmium and nickel at Pinto Island.

106. The removal efficiency for other parameters was either higher or lower than the total solids removal. A compilation of the percent removal efficiencies of constituents in the total samples is presented in the following table (plus sign means concentration was increased).

	Total Solids	Cation Exchange Capacity	NH_3-N	Organic-N
Pinto Island	45.8	58.5	(+29.4)	(60.1)
Grassy Island	99.7	--	83.1	95.8

	Total-P	Total Carbon	TOC	Oil & Grease
Pinto Island	(42.8)	59.3	+111	90.1
Grassy Island	99.8	55.1	61.9	99.7

	Ca	K	Mg	Cd	Cu	Fe	Hg
Pinto Island	(23)	54	--	18	52	46	35
Grassy Island	(44)	61	10	99.6	93	99	96

	Mn	Ni	Pb	Se	Ti	V	Zn
Pinto Island	54	67	35	39	48	45	35
Grassy Island	(98)	95	(99)	(97)	97	(96)	98

	op'DDD	pp'DDD	op'DDE	pp'DDE
Pinto Island	(59)	70	75	75
Grassy Island	99.0	99.6	99.6	99.4

	Aroclor 1242	Aroclor 1254	Aroclor 1260	Total PCB
Pinto Island	96	97	99	96.5
Grassy Island	98.9	99.8	99.8	99.1

107. Several reasons can be given for removal efficiencies higher than the total solids removal.

a. Chemical constituents were associated more predominantly with larger particulates which are removed during the detention time.

b. During resedimentation chemical reactions occurred which promoted precipitation of

soluble species.

c. The soluble species were adsorbed by clay minerals and/or hydrated oxides of iron and manganese.

108. For parameters that showed lower removal efficiencies than the total solids, the following reasons are suggested:

a. A significant amount of some parameters were associated with the soluble phase of the total sample, such as sodium, calcium, magnesium, NH_3-N, total carbon, and organic carbon. The settling process could not remove most of the soluble species; hence, the removal efficiency was lower than that of the total solids removal.

b. Some of these parameters were associated primarily with the solid phase of the total sample. However, they were more concentrated in the smaller particles and could not be effectively removed during the detention period.

c. During resedimentation, chemical or physical reactions may have altered the original constituents to more soluble species.

Transformation of Metal Solids During Confined Land Disposal

109. The importance of the transformation of geochemical phases in promoting the migration of metals has been discussed.[5] The important relations can be summarized as follows:

a. Transformation of geochemical phases will change the controlling solids of metals, thus altering the solubility of the metals in solution.

b. Through the dynamic equilibrium the controlling solids of metals can also regulate the exchangeable amounts of metals in the sediments.

110. Since polluted sediments are usually in reduced states, the controlling solids of the in situ sediments are usually reduced solids such as metallic sulfides. Upon

resedimentation of the suspended solids in aerobic environments, other solids such as carbonates, hydroxides, oxyhydroxides, hydrated oxides, or even silicates can be formed. In general, the changes in the acetic acid-extractable phases and exchangeable phases can give information concerning major changes. Data from this study show that the acetic acid extractable phase of Zn increased after disposal of dredged material. It is likely that this increase mainly represents an increase in zinc carbonate solids. The amounts of As, Cd, Cr, Cu, Fe, Mn, Ni, Pb, and V in the acetic acid-extractable phase either decreased or were unchanged, showing that carbonate solids of these metals are either unstable or rates of formation are slow. Therefore, other reducible solids such as hydroxides, oxides, or silicates could be predominant. The following solids are suggested as the most likely formation products for the studied metals by the ion-ratio method:[5]

a. Cu: $Cu_2CO_3(OH)_2$
b. Cd: $CdCO_3$
c. Zn: $ZnCO_3$ or $ZnSiO_3$
d. Ni: $NiCO_3$
e. As: As_2O_3
f. Cr: $Cr(OH)_3$
g. Fe: $Fe(OH)_3$, FeOOH
h. Pb: $Pb(OH)_2(CO_3)_2$, or PbO or $PbCO_3$
i. V: $V(OH)_2$, $V(OH)_3$ or V_2O_3 or V_2O_5
j. Mn: $Mn(OH)_x$, MnOOH, or MnO_x

111. If the equilibria exist as predicted by thermodynamic considerations, the free metal ion concentrations, with the exception of Fe and Mn, will be increased under oxidizing conditions during confined area disposal.

112. As suggested by Jackson[7] and Lu[5], from the dynamic equilibrium among controlling solids and the easily released fractions of metals, the following relation can be

established:

water soluble metals $\rightleftarrows$ exchangeable metals $\rightleftarrows$ controlling solids of metals

113. Under oxidizing conditions, the newly formed controlling solids will generally have increased solubility; therefore, the exchangeable amounts of metals are likely to increase; however, the data show that cadmium, copper, and zinc were the only metals whose exchangeable phase concentrations increased during disposal in a containment area. The exchangeable phase concentrations of As, Cr, Fe, Mn, Ni, Pb, and V either decreased or were unchanged which may be the result of pH changes, competing mechanisms, and kinetic reaction rates, e.g., (a) incomplete oxidation of metallic sulfides to the more soluble controlling solids; (b) ion selectivity (preferential exchange) and exchange kinetics; (c) adsorption of free metal ions by clay minerals and hydrated oxides of iron and manganese.

114. Since there is likely to be a relationship between the potential pollutional effects and the particle size distribution, the collected influent and effluent samples were separated into three fractions:

a. 0.05-μ filtrate - defined as the soluble fraction.

b. 0.05-μ to 8-μ fraction - for determining the content of pollutants in medium-size suspended particulates.

c. Larger than 8-μ fraction - for identifying the association of pollutants with settleable particulates.

115. Results of the fractionation study show that most of the contaminants in the influent and effluent samples were associated with settleable particulates. With the exception of major ions, such as sodium, potassium, calcium, magnesium, and chloride, only a very small por-

tion of the chemical constituents was in the soluble fraction. The concentrations in the medium-size particulates were also at a very low level. Table 6 gives the comparison of the size fractionation of pollutants. Since large particulates will generally settle within properly managed containment areas, the impact caused by this fraction is relatively short-term. On the other hand, the soluble fraction and medium-size suspended particulates may be the most important fraction as a source for potential pollutional effects. These substances can be transported in the effluents, and thus present a potential for the pollution of the receiving waters.

Pollutional Potential of Soluble Fraction of Pollutants

116. Information on soluble constituents in influents and effluents is very important due to the availability of soluble contaminants for biological uptake. The following sections discuss the fate of soluble constituents in confined dredged material disposal areas.

Removal of major soluble ions

117. The removal of soluble calcium and magnesium was insignificant with the exception of 54% removal of magnesium at Grassy Island. This removal might have been caused by pH changes due to photosynthetic reactions.

Removal of carbon, nitrogen, and phosphorus compounds

118. Carbon species in the influent samples may be derived mainly from the interstitial water. Upon mixing of background water with dredged sediments, additional inorganic and organic carbon may be released from the dredged slurry solids. Inorganic species either increased or decreased after diked disposal, depending on the regulating mechanisms, i.e., dissolution or precipitation of carbonate solids. The bio-oxidation of organic carbon to carbon di-

oxide may contribute additional inorganic carbon during the detention period. Since the confined area is an open system, the loss or diffusion of carbon dioxide cannot be ruled out. Photosynthetic reactions can also reduce the concentration of inorganic carbon dioxide.

119. Total organic carbon was increased by 111% at Pinto Island probably as a result of the selective removal of the heavier mineral particles and the release of indigenous organic matter from the site. Total organic carbon at Grassy Island was reduced by 62%. This decrease was probably due to both the efficient removal of suspended solids and the biological oxidation of soluble organic carbon, with respiration exceeding photosynthesis.

120. The removal of NH_3-N, organic N, and NO_3-N at Pinto Island was not significant. At Grassy Island, 83% NH_3-N and 96% organic N in the total samples were removed. In an oxidizing environment, the bacterial decomposition of organic N to NH_3-N and subsequent nitrification should cause an increase in the nitrate concentration. However, nitrate levels in the effluent samples did not show a significant increase, suggesting possible removal by denitrification and biological uptake by vegetation and algae. Ion exchange and adsorption by clay minerals may also account for some of the nitrate removal. Nitrite species are generally unstable in both aerobic and anaerobic environments and were not detected in this study.

121. The release or precipitation of phosphate depends to a great extent on the form and concentration of soluble iron. Under aerobic conditions at neutral pH, the $FePO_4$ solid is very stable and can limit the soluble phosphate level to about 0.09 ppm [6]. The soluble phosphate level may also be decreased by vegetation uptake and adsorption by clay minerals and ferric hydroxide precipitates.

Removal of Trace Metals

122. Under oxidizing conditions, newly formed metallic carbonate, hydroxide, and silicate solids could increase the solubility of most trace metals during detention. However, most soluble (< 0.05-μ) trace metal concentrations were reduced in the effluent samples. The following reasons are suggested:

a. The solubility-controlling solids might remain as metallic sulfides instead of being transformed to carbonates, hydroxides or silicates due to short detention times. Therefore, the concentrations of soluble metals could not be increased.

b. The decrease of metal ligands in the effluents as suggested by the decrease in TOC may account for the decrease in metal-organic complexes.

c. The soluble iron and manganese concentrations were quite high in the influents; these could be oxidized in the presence of oxygen to form hydrated oxides which could scavenge most of the other soluble metals from the solution.

Effluent Discharge From Confined Disposal Areas vs. Pertinent Water Quality Criteria

123. A summary of the effluent data in Table 8 is compared with the California State Water Resources Control Board (CSWRCB) ocean water discharge standards of 1972[8] and the 1973 marine water quality criteria proposed by the National Academy of Science (NAS) and the EPA.[9] The results are compared for general parameters, chlorinated hydrocarbons, soluble trace metal concentrations, and total trace metal concentrations. It should be noted that the CSWRCB, NAS, and EPA water quality criteria do not differentiate between soluble and particulate concentrations, i.e., the criteria in Table 8 are based on total concentrations.

General parameters

124. Dissolved Oxygen. Dissolved oxygen in the Grassy Island effluents was slightly higher than the background water (7 mg/l). The effluent D.O. at Pinto Island was 3 mg/l. This level is lower than the EPA marine water quality criteria. However, if the dilution ratio of the receiving waters is larger than 5, it will meet the CSWRCB and the EPA criteria; a dilution ratio of 5 should be obtainable in most situations of effluent discharges. Therefore, required D.O. levels would be achieved, e.g.,

$$[3(1) + 7.5(5)]/[1 + 5] = 6.75$$

125. pH. Effluent pH levels are acceptable.

126. Oil and grease. The California ocean discharge standards for oil and grease are 10 mg/l for less than 50% of the time and 15 mg/l for less than 10% of the time. Grassy Island effluent meets the 10% value but not the 50% value; however, the oil and grease levels in the Pinto Island effluent were three times the 10% required concentration value, and 4-1/2 times the 50% value.

127. Suspended solids. Suspended solids in the Grassy Island effluent satisfy the CSWRCB criteria; suspended solids in the Pinto Island effluent were somewhat higher than the acceptable level. Increased detention times or treatment may be necessary in some cases in order to meet applicable water quality criteria.

128. NH_3-N. Ammonium levels in both disposal area effluents were higher than both EPA and NAS marine water quality criteria.

129. NO_3-N. Nitrate levels in the effluents at both sites ranged from 0.1 - 0.25 mg/l. The listed criteria do not specify a required nitrate level. Since the background water contained about 0.1 mg/l nitrate, it is evident that the effluent levels were not significantly higher than the

background water. The nitrate criterion suggested by both the EPA and NAS for fresh water (public supply) is 10 mg/l [10]. Therefore, the effluent concentrations at both sites are considered acceptable.

130. Phosphorus. Soluble orthophosphate in the effluents at both sites meets the NAS and EPA marine water quality criteria. The total phosphorus concentrations in the effluents at both sites were much higher than the NAS and EPA criteria.

Chlorinated hydrocarbons

131. The CSWRCB standards for total chlorinated hydrocarbons are 2 μg/l for less than 50% of the time and 4 μg/l for less than 10% of the time. Results show that the total chlorinated hydrocarbons in effluents at both sites were much higher than the standards. The settling tests indicate that most of the chlorinated hydrocarbons were associated with the particulate phase; therefore, increased detention times or treatment would be required in order to meet water quality criteria. This is particularly true at the Pinto Island site where only 46% of the total solids were removed. The Grassy Island site presents a different problem in that 99.7% of the total solids were removed; it is not known if the removal of additional suspended solids would lower the total chlorinated hydrocarbon concentrations to an acceptable level.

Soluble trace metal concentrations

132. The soluble (< 0.05-μ) trace metal concentrations in the effluents at both sites meet the CSWRCB, NAS, and EPA marine water quality criteria.

Total trace metal concentrations

133. In general, the total trace metal concentrations in the effluents at both sites were significantly higher than the NAS, EPA, and CSWRCB water quality re-

quirements, e.g., the total zinc concentration in the effluent at Pinto Island was over 100 times the allowable NAS level. The analytical results show that most of the trace metal concentrations are associated with the solid phase; therefore, increased detention times or treatment (coagulation) would be required to meet applicable water quality criteria.

PART V: CONCLUSIONS

134. The conclusions drawn from the analysis of data in this study are as follows:

- a. The results show that the trace metal concentrations in both the solid and soluble phases of the influents were higher than the background water levels with the exception of soluble zinc at Pinto Island. The release of soluble trace metals was in the ppb and sub-ppb range. The initial release is most likely due to the mixing of interstitial waters, oxidation of metallic sulfides, dissolution, complex formation, and ion exchange.
- b. The increase of total metal concentrations in the influent samples is primarily associated with the solid phase, i.e., 97 to 99%. Grassy Island showed higher levels of increase due to the greater solids content of the influent, i.e., 187 g/l vs. 71 g/l for Pinto Island.
- c. Trace amounts of soluble sulfide were measured in the influents at both sites, indicating possible oxidation of sulfide species during dredging operations and transportation to the confined disposal areas. However, these values may be somewhat unreliable as they were not obtained directly in the field.
- d. The results of the geochemical phase transformation study suggest that the concentrations of soluble trace metals under oxidizing conditions should increase during confined area disposal; however, most of these metal concentrations were decreased in the effluents. The observed reduction of soluble trace metals may be due to the following: (1) incomplete oxidation of metallic sulfides due to short detention times; (2) removal in the exchangeable phase; (3) decrease of metal ligands; and (4) coprecipitation or incorporation with the hydrated oxides of iron and manganese.
- e. In general, the removal efficiency of trace metals in the total samples was very similar to the total solids removal. These results are in agreement with the analytical data

which show that the major portion of the total trace metals was associated with the solid phase.

f. There was almost complete removal of total solids at the Grassy Island disposal area (99.7%) compared to the 46% removal at Pinto Island. The high solids removal at Grassy Island was due to long detention times obtained by total confinement procedures. The relatively poor removal of total solids at Pinto Island was due to the high concentration of dissolved solids (as indicated by high conductivity values) in conjunction with reduced detention times resulting from observed "short-circuiting" in the disposal area and subsequent discharge of the effluent over a weir at a 4-inch hydraulic head.

g. The observed decrease in total NH_3-N and organic N in an oxidizing environment should result in an increase in the nitrate concentration. However, at Grassy Island, nitrate levels did not show a significant increase in the effluent samples, suggesting that some denitrification, ion exchange of ammonium, biological uptake, and/or inhibition of nitrification occurred in the disposal area.

h. The decrease of total organic carbon at Grassy Island was probably due to both the removal of settleable solids and the biological oxidation of soluble organic carbon. The increase of total organic carbon at Pinto Island is probably the result of biological uptake and subsequent decomposition of organic matter at the site.

i. Phosphorus compounds in the soluble phase were below detection limits. The level of soluble phosphate may be limited by $FePO_4$ precipitates, biological uptake, or adsorption by clay minerals and ferric hydroxide precipitates.

j. The nearly complete removal of chlorinated hydrocarbons during the settling test indicates that the association of chlorinated hydrocarbons with the oil and grease fraction is not a signficant factor. These results indicate that the chlorinated hydrocarbons were largely associated with large

sediment particles.

k. The decrease in alkalinity at Grassy Island may be the result of uptake of carbon dioxide during photosynthesis and the subsequent pH increase promoting the precipitation of calcium carbonate.

l. The increase in alkalinity at Pinto Island may be due to the oxidation of organic carbon to carbon dioxide followed by the dissolution of solid metal carbonate to yield predominately bicarbonate species.

m. The results show that the concentration of soluble trace metals in Grassy Island and Pinto Island effluents were in the ppb or sub-ppb range. These concentrations are well below the CSWRCB ocean water discharge standards and the NAS and EPA marine water quality criteria. Therefore, the water quality impact of soluble trace metals in effluents discharged into the receiving waters is considered to be negligible.

n. The results indicate that dissolved oxygen levels, and concentrations of oil and grease, chlorinated hydrocarbons, NH_3-N, solid phosphates, and suspended solids may pose a potential water quality problem. In general, these parameters could not meet the CSWRCB, NAS, and EPA water quality criteria.

o. The CSWRCB, NAS, and EPA marine water quality criteria are based on total concentrations. The results of this study show that the total trace metal concentrations in the effluents at both Grassy Island and Pinto Island disposal areas were significantly higher than the referenced water quality criteria. While the extent of redissolution is very small, contaminants attached to the particles can be transported by the effluent to the receiving waters. The ecological significance of these particles cannot be well-defined at present. Nevertheless, trace metals and chlorinated hydrocarbons associated with suspended particles, including macromolecular organic complexes, may pose some problems due to the possible biological uptake.

p. It is concluded that confined disposal operations will require either long detention

times or treatment in order to meet CSWRCB, NAS, and EPA effluent water quality requirements. One possible solution to minimize this problem is the direct treatment of dredged material or discharged effluents by the addition of coagulants to improve the settling characteristics of suspended particulates.

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TABLE 1

Pinto Island (Mobile Bay, Alabama) and Grassy Island (Detroit, Michigan) Dredged Material Disposal Sites, Sample History and Qualitative Sample Description (Upon Arrival at U.S.C.)

Site	USC Sample Code	Date Of Sample Collection	Turbidity	Color	Smell	Greasy Appearance e.g.Oil Emulsions
Pinto Island (Mobile Bay, Alabama)	BW (A-D)	9-8-76	None	None	None	None
	INF 1 (A-D)	9-7-76	Moderate	Moderately Grey and Brown	None	None
	EFF 1 (A-F)	9-8-76	Low	Light Grey and Brown	None	None
	INF 2 (A-D)	9-8-76	High	Moderately Orange and Brown	Moderately Oily	Moderate
	EFF 2 (A-F)	9-8-76	Low	Light and Brown	Slightly Oily	Slight
	INF 3 (A-D)	9-8-76	High	Dark Brown and Orange	Moderately Oily	Moderate
	EFF 3 (A-F)	9-8-76	Moderate	Light Brown and Orange	Slightly Oily	Slight
Grassy Island (Detroit, Michigan)	BW (A-C)	8-26-76	Very Very Low	Slightly Brown	None	None
	INF 1 (A-D)	8-24-76	High	Dark Brown	Moderately Oily	Moderate
	EFF 1 (A-D)	8-24-76	Very Low	Light Yellow and Green	None	None
	INF 2 (A-D)	8-25-76	High	Dark Brown	Moderately Oily	Moderate
	EFF 2 (A-D)	8-25-76	Very Low	Light Yellow and Green	None	None
	INF 3 (A-D)	8-25-76	Moderate	Dark Orange and Brown	Moderately Oily	Moderate
	EFF 3 (A-D)	8-25-76	Very Low	Light Yellow and Green	None	None

TABLE 2

STATISTICAL CHARACTER OF BACKGROUND WATER, INFLUENT AND EFFLUENT SAMPLES FOR PINTO ISLAND, MOBILE BAY, ALABAMA - SITE SPECIFIC ANALYSIS

Parameters	Number Of Samples			Range			Mean		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water	Influent	Effluent	Background Water
PH									
Slurry	—	—	—	*	*	*	*	*	*
(<0.45-μ)	6	11	2	7.1-8.0	7.4-8.2	7.5-7.6	7.3	7.8	7.6
Salinity, $^{0}/_{00}$									
Slurry	6	7	3	11.5-15.8	8.5-16.1	3.5-3.6	14.0	13.4	3.4
(<0.45-μ)	6	11	2	24.0-28.0	18.0-23.0	3.0-3.0	25.5	20.5	3.0
Conductivity, mMhos									
Slurry	6	6	3	20.6-26.9	20.1-27.7	6.2-6.5	24.3	24.9	6.3
(<0.45-μ)	6	11	2	22.5-25.9	18.0-25.9	4.0-5.9	24.8	22.0	4.9
Water Temp, °C	5	7	3	25.5-28.5	26.8-30.0	27.5-28.2	27.8	28.4	27.7
Dry Weight, %	6	11	2	4.80-11.1	3.09-5.32	0.42-0.50	7.06	3.83	0.46
D.O., mg/l	6	9	3	0.50-1.20	0.30-4.20	7.45-7.75	0.65	2.40	7.58
Alkalinity, mg/l as $CaCO_3$ (<0.45-μ)	6	11	2	80-202	136-270	50	151	213	50

Parameters	Standard Deviation			F - Value Influent vs. Background W	F - Value Influent vs. Effluent	F - Value Effluent vs. Background W	Loading Influent vs. Background W	Removal Influent vs. Effluent	Impact Effluent vs. Background W
	Influent	Effluent	Background Water						
PH									
Slurry	*	*	*	*	*	*	*	*	*
(<0.45-μ)	0.407	0.311	0.071	33.0	1.70	19.4	$NSD_{1,5}$	$NSD_{1,5}$	$NSD_{1,5}$
Salinity, $^{0}/_{00}$									
Slurry	1.93	2.95	0.058	1250	2.32	2900	$SD_{1,5}$	$NSD_{1,5}$	$SD_{1,5}$
(<0.45-μ)	1.76	2.07	0.00	∞	1.38	∞	$SD_{1,5}$	$NSD_{1,5}$	$SD_{1,5}$
Conductivity, mMhos									
Slurry	2.88	3.63	0.173	277	1.58	438	$SD_{1,5}$	$NSD_{1,5}$	$SD_{1,5}$
(<0.45-μ)	1.20	3.03	1.34	1.26	6.40	5.10	$NSD_{1,5}$	SD_5	$NSD_{1,5}$
Water Temp, °C	1.32	1.30	0.404	10.7	1.02	10.4	$NSD_{1,5}$	$NSD_{1,5}$	$NSD_{1,5}$
Dry Weight, %	2.55	0.602	0.056	2170	17.9	121	SD_5	$SD_{1,5}$	$NSD_{1,5}$
D.O., mg/l	0.274	1.36	0.153	3.26	24.7	80.5	$NSD_{1,5}$	$SD_{1,5}$	SD_5
Alkalinity, mg/l as $CaCO_3$ (<0.45-μ)	55.0	40.7	0	∞	1.83	∞	$SD_{1,5}$	$NSD_{1,5}$	$SD_{1,5}$

Continued

(—) - Not Determined (Insufficient Sample or Sample Destroyed In Transit).
(Δ) - Not Enough Solids To Perform Analysis.
(*) - Cannot Ascertain Since Not Determined Or Not Enough Solids to Perform Analysis.
(•) - Cannot Ascertain Since Only One Sample Analyzed.
$SD_{1,5}$ - Significant Difference at $P \leq 0.05$ and $P \leq 0.01$.
$NSD_{1,5}$ - No Significant Difference At Either $P \leq 0.05$ or $P \leq 0.01$.
SD_5 - Significant Difference at $P \leq 0.05$ only.
ND - No Difference (Difficult To Decide on Significance of Difference Since Values Compared Are At Trace Levels).

Table 2 (Continued)

Parameters	Number Of Samples: Influent	Number Of Samples: Effluent	Number Of Samples: Background Water	Range: Influent	Range: Effluent	Range: Background Water	Mean: Influent	Mean: Effluent	Mean: Background Water
Chloride, mg/l (<0.45-μ)	6	11	2	12.2-15.2	10.1-13.3	1.90	13.5	11.6	1.90
Cation Exchange Capacity, meq/l	6	12	Δ	3.6-58.7	4.3-24.6	*	28.4	11.8	*
Acid Soluble Sulfide, mg/l	5	11	2	15.1-27.9	1.5-5.9	<0.1	19.6	3.3	TRACE
Total-C, mg/l									
Slurry	5	10	2	40.0-93.8	52.5-342	16.3-20.0	59.3	93.8	18.2
(<8-μ)	5	11	2	23.0-52.5	45.0-76.3	13.8-14.0	39.8	57.0	13.9
(<0.45-μ)	5	11	2	23.2-49.0	40.0-75.0	11.3	38.4	55.2	11.3
(<0.05-μ)	5	11	2	23.0-48.0	41.3-72.5	12.0-12.5	38.4	52.5	12.3
Organic-C, mg/l									
Slurry	6	10	2	7.5-31.3	7.1-264	4.4-10.0	19.4	40.4	7.2
(<8-μ)	6	11	2	7.0-14.5	2.5-16.3	4.0-5.0	10.3	8.5	4.5
(<0.45-μ)	6	11	2	7.0-14.5	2.5-12.5	2.5-3.8	10.3	6.4	3.2

Parameters	Standard Deviation: Influent	Standard Deviation: Effluent	Standard Deviation: Background Water	F - Value Influent vs. Background W	F - Value Influent vs. Effluent	F - Value Effluent vs. Background W	Loading Influent vs. Background W	Removal Influent vs. Effluent	Impact Effluent vs. Background W
Chloride, mg/l (<0.45-μ)	1.37	1.34	0	∞	1.06	∞	$SD_{1,5}$	$NSD_{1,5}$	$SD_{1,5}$
Cation Exchange Capacity, meq/l	20.0	7.47	*	*	7.19	*	*	$SD_{1,5}$	*
Acid Soluble Sulfide, mg/l	4.94	1.35	~0	∞	13.4	∞	$SD_{1,5}$	$SD_{1,5}$	$SD_{1,5}$
Total-C, mg/l									
Slurry	21.1	87.9	2.62	65.1	17.4	1130	$NSD_{1,5}$	$SD_{1,5}$	SD_5
(<8-μ)	14.5	9.26	0.141	10500	2.45	4290	$SD_{1,5}$	$NSD_{1,5}$	SD_5
(<0.45-μ)	13.2	10.5	0	∞	1.57	∞	$SD_{1,5}$	$NSD_{1,5}$	$SD_{1,5}$
(<0.05-μ)	12.5	10.2	0.353	1260	1.52	827	SD_5	$NSD_{1,5}$	SD_5
Organic-C, mg/l									
Slurry	10.9	79.1	3.96	7.58	52.6	399	$NSD_{1,5}$	$SD_{1,5}$	SD_5
(<8-μ)	3.11	4.04	0.707	19.3	1.69	32.6	$NSD_{1,5}$	$NSD_{1,5}$	$NSD_{1,5}$
(<0.45-μ)	3.58	2.95	0.919	15.1	1.47	10.3	$NSD_{1,5}$	$NSD_{1,5}$	$NSD_{1,5}$

Continued

Table 2 (Continued)

Parameters	Number Of Samples			Range			Mean		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water	Influent	Effluent	Background Water
(<0.05-μ)	5	11	2	6.5-13.0	4.5-12.5	3.0-3.2	9.8	6.8	3.1
Oil & Grease, mg/l									
Slurry	6	11	2	287-684	16-105	3-4	456	45	3.5
NH_3-N, mg/l									
Slurry	3	2	1	1.90-22.3	8.93-17.5	•	10.19	13.2	•
(<8-μ)	3	2	1	0.78-13.1	0.96-3.29	•	5.10	2.13	•
(<0.45-μ)	3	2	1	0.64-12.6	0.80-3.19	•	4.83	1.99	•
(<0.05-μ)	1	2	1	•	0.61-1.81	•	•	1.21	•
Organic-N, mg/l									
Slurry	3	2	1	17.5-43.8	8.20-16.7	•	31.1	12.5	•
(<8-μ)	3	2	1	6.22-9.17	7.44-7.49	•	7.47	7.47	•
(<0.45-μ)	3	2	1	6.10-13.5	6.10-8.05	•	8.78	7.08	•
(<0.05-μ)	2	1	1	6.10-12.0	•	•	9.05	•	•
NO_3-N, mg/l									
(<0.45-μ)	3	2	1	0.26-0.30	0.22-0.24	•	0.28	0.23	•
NO_2-N, mg/l (<0.45-μ)	3	2	1	<0.01	<0.01	•	TRACE	TRACE	•

Parameters	Standard Deviation			F - Value	F - Value	F - Value	Loading	Removal	Impact
	Influent	Effluent	Background Water	Influent vs. Background W	Influent vs. Effluent	Effluent vs. Background W	Influent vs. Background W	Influent vs. Effluent	Effluent vs. Background W
(<0.05-μ)	2.66	2.39	0.141	355	1.24	286	SD$_5$	NSD$_{1,5}$	SD$_5$
Oil & Grease, mg/l Slurry	147	27.4	0.707	43500	28.9	1500	SD$_{1,5}$	SD$_{1,5}$	SD$_5$
NH_3-N, mg/l									
Slurry	10.7	6.06	•	•	3.13	•	•	NSD$_{1,5}$	•
(<8-μ)	6.93	1.65	•	•	17.8	•	•	NSD$_{1,5}$	•
(<0.45-μ)	6.73	1.69	•	•	15.8	•	•	NSD$_{1,5}$	•
(<0.05-μ)	•	0.848	•	•	•	•	•	•	•
Organic-N, mg/l									
Slurry	13.2	6.01	•	•	4.80	•	•	NSD$_{1,5}$	•
(<8-μ)	1.53	0.035	•	•	47.0	•	•	NSD$_{1,5}$	•
(<0.45-μ)	4.10	1.38	•	•	8.84	•	•	NSD$_{1,5}$	•
(<0.05-μ)	4.17	•	•	•	•	•	•	•	•
NO_3-N, mg/l									
(<0.45-μ)	0.021	0.014	•	•	2	•	•	NSD$_{1,5}$	•
NO_2-N, mg/l (<0.45-μ)	~ 0	~ 0	•	•	IND.	•	•	ND	•

Continued

Table 2 (Continued)

Parameters	Number Of Samples			Range			Mean		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water	Influent	Effluent	Background Water
Total-P, mg/l									
Slurry	3	2	1	68-80	37.5-47.5	•	74.3	42.5	•
(<8-μ)	3	2	1	<0.01	<0.01	•	TRACE	TRACE	•
(<0.45-μ)	3	2	1	<0.01	<0.01	•	TRACE	TRACE	•
<0.05-μ)	3	2	1	<0.01	<0.01	•	TRACE	TRACE	•
Sodium,									
Slurry, mg/l	—	—	1	*	*	•	*	*	•
(<8-μ), mg/l	5	8	2	7950-8700	6300-7350	1200-1350	8460	6730	1275
(<0.45-μ), mg/l	3	2	2	7350-7950	5700-6600	1200-1350	7600	6150	1275
(<0.05-μ), mg/l	5	5	1	7200-7950	5700-6150	•	7570	5850	•
Potassium									
Slurry, mg/l	4	12	—	1110-2700	583-923	*	1630	745	*
Solids, mg/l	4	11	—	14700-56200	14100-27000	*	26900	19500	*
(<8-μ), mg/l	4	12	—	178-191	116-155	*	184	136	*
(<0.45-μ), mg/l	4	12	—	169-184	108-153	*	175	129	*
(0.05-μ), mg/l	4	12	—	156-171	98-156	*	164	126	*
Calcium									
Slurry, mg/l	4	12	2	623-718	423-618	66.3-69.7	668	513	68
Solids, mg/l	4	11	2	903-13600	11000-16700	13900-15800	8090	13300	14900
(<8-μ), mg/l	4	12	2	450-520	275-415	65.0-66.5	470	327	65.8
(<0.45-μ), mg/l	4	12	2	438-499	255-398	63.3-65.2	462	311	64.3
(<0.05-μ), mg/l	4	12	2	418-473	217-359	61.4-62.8	440	287	62.1

Parameters	Standard Deviation			F - Value Influent vs. Background W	F - Value Influent vs. Effluent	F - Value Effluent vs. Background W	Loading Influent vs. Background W	Removal Influent vs. Effluent	Impact Effluent vs. Background W
	Influent	Effluent	Background Water						
Total-P, mg/l									
Slurry	6.03	7.07	•	•	1.37	•	•	$NSD_{1,5}$	•
(<8-μ)	~ 0	~ 0	•	•	IND	•	•	ND	•
(<0.45-μ)	~ 0	~ 0	•	•	IND	•	•	ND	•
<0.05-μ)	~ 0	~ 0	•	•	IND	•	•	ND	•
Sodium,									
Slurry, mg/l	*	*	•	*	*	*	*	*	*
(<8-μ), mg/l	345	484	106	10.6	1.96	20.8	$NSD_{1,5}$	$NSD_{1,5}$	$NSD_{1,5}$
(<0.45-μ), mg/l	312	636	106	8.66	4.15	36.0	$NSD_{1,5}$	$NSD_{1,5}$	$NSD_{1,5}$
(<0.05-μ), mg/l	297	212	•	•	1.96	•	•	$NSD_{1,5}$	•
Potassium									
Slurry, mg/l	738	94.8	*	*	60.7	*	*	$SD_{1,5}$	*
Solids, mg/l	19800	3540	*	*	31.5	*	*	$SD_{1,5}$	*
(<8-μ), mg/l	62.4	12.7	*	*	4.15	*	*	$NSD_{1,5}$	*
(<0.45-μ), mg/l	6.56	13.1	*	*	4.03	*	*	$NSD_{1,5}$	*
(0.05-μ), mg/l	8.00	17.1	*	*	4.71	*	*	$NSD_{1,5}$	*
Calcium									
Slurry, mg/l	40.4	65.6	2.40	283	2.63	744	SD_5	$NSD_{1,5}$	SD_5
Solids, mg/l	5300	1830	1340	15.6	8.42	1.84	$NSD_{1,5}$	$SD_{1,5}$	$NSD_{1,5}$
(<8-μ), mg/l	33.4	45.4	1.06	988	1.84	1820	SD_5	$NSD_{1,5}$	SD_5
(<0.45-μ), mg/l	26.2	45.9	1.34	379	3.08	1170	SD_5	$NSD_{1,5}$	SD_5
(<0.05-μ), mg/l	25.2	46.4	0.989	649	3.38	2200	SD_5	$NSD_{1,5}$	SD_5

Continued

Table 2 (Continued)

Parameters	Number Of Samples			Range			Mean		
	Influent	Efluent	Background Water	Influent	Effluent	Background Water	Influent	Effluent	Background Water
Magnesium									
Slurry,mg/l	—	—	—	*	*	*	*	*	*
Solids,mg/kg	—	—	—	*	*	*	*	*	*
(<8-µ),mg/l	4	12	2	1150-1510	759-1280	215-229	1330	1060	222
(<0.45-µ),mg/l	4	12	2	1020-1420	752-1160	210-223	1220	959	216
(<0.05-µ),mg/l	4	12	2	966-1310	787-1100	189-195	1170	923	192
Arsenic									
Slurry,mg/l	—	—	—	*	*	*	*	*	*
In Oil & Grease/µg/l	4	12	—	0.53-0.59	<0.01-0.92	*	0.56	0.27	*
Carb.Phase,mg/kg	6	12	Δ	0.220-0.620	0.170-0.40	*	0.376	0.315	*
Exch.Phase,mg/kg	6	12	Δ	0.080-0.340	0.110-0.430	*	0.192	0.268	*
Cadmium									
Slurry,µg/l	6	12	2	63-104	47.4-94.5	2.12-2.63	89.3	73.1	2.38
Solids,mg/kg	6	11	2	0.57-2.10	1.35-2.40	0.42-0.63	1.41	1.86	0.53
(<8-µ),µg/l	4	12	2	3.00-3.75	0.44-5.23	0.87-1.11	3.39	2.92	0.99
(<0.45-µ),µg/l	4	12	2	2.47-3.33	0.21-4.21	0.87-0.98	2.94	2.23	0.93
(<0.05-µ),µg/l	4	12	2	2.43-2.93	0.17-3.92	0.66-0.73	2.68	2.00	0.69
In Oil & Grease/µg/l	4	12	2	1.33-1.77	<0.01-0.14	<0.01	1.54	0.05	TRACE

Parameters	Standard Deviation			F - Value	F - Value	F - Value	Loading	Removal	Impact
	Influent	Effluent	Background Water	Influent vs. Background W	Influent vs. Effluent	Effluent vs. Background W	Influent vs. Background W	Influent vs. Effluent	Effluent vs. Background W
Magnesium									
Slurry,mg/l	*	*	*	*	*	*	*	*	*
Solids,mg/kg	*	*	*	*	*	*	*	*	*
(<8-µ),mg/l	171	158	9.89	299	1.17	255	SD_5	$NSD_{1,5}$	SD_5
(<0.45-µ),mg/l	179	117	9.19	378	2.34	161	SD_5	$NSD_{1,5}$	$NSD_{1,5}$
(<0.05-µ),mg/l	146	105	4.24	2670	1.93	1380	SD_5	$NSD_{1,5}$	SD_5
Arsenic									
Slurry,mg/l	*	*	*	*	*	*	*	*	*
In Oil & Grease/µg/l	0.028	0.319	*	*	146	*	*	$SD_{1,5}$	*
Carb.Phase,mg/kg	0.168	0.119	*	*	2.00	*	*	$NSD_{1,5}$	*
Exch.Phase,mg/kg	0.089	0.077	*	*	1.33	*	*	$NSD_{1,5}$	*
Cadmium									
Slurry,µg/l	18.9	17.9	0.361	2760	1.11	2480	SD_5	$NSD_{1,5}$	SD_5
Solids,mg/kg	0.540	0.396	0.148	13.2	1.85	7.14	$NSD_{1,5}$	$NSD_{1,5}$	$NSD_{1,5}$
(<8-µ),µg/l	0.307	1.70	0.169	3.13	30.6	95.9	$NSD_{1,5}$	$SD_{1,5}$	$NSD_{1,5}$
(<0.45-µ),µg/l	0.389	1.38	0.078	25.2	12.5	315	$NSD_{1,5}$	$SD_{1,5}$	SD_5
(<0.05-µ),µg/l	0.213	1.33	0.049	22.5	39.4	886	$NSD_{1,5}$	$SD_{1,5}$	SD_5
In Oil & Grease/µg/l	0.182	0.058	~ 0	∞	11.0	∞	$SD_{1,5}$	$SD_{1,5}$	$SD_{1,5}$

(Continued)

Table 2 (Continued)

Parameters	Number Of Samples			Range			Mean		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water	Influent	Effluent	Background Water
Carb. Phase, mg/kg	6	12	Δ	0.034-0.22	0.090-0.206	*	0.088	0.143	*
Exch. Phase, mg/kg	6	12	Δ	0.007-0.016	0.027-0.088	*	0.010	0.052	*
Chromium									
Slurry, mg/l	—	—	—	*	*	*	*	*	*
In Oil & Grease, μg/l	4	12	—	0.32-0.93	<0.01-0.69	*	0.73	0.44	*
Carb. Phase, mg/kg	6	12	Δ	0.60-1.11	0.59-1.07	*	0.90	0.78	*
Exch. Phase, mg/kg	6	12	Δ	0.14-0.28	0.15-0.46	*	0.21	0.24	*
Copper									
Slurry, mg/l	6	12	2	1.79-4.41	0.70-2.34	0.31-0.55	2.73	1.31	0.43
Solids, mg/kg	6	11	2	23.7-91.7	13.2-66.1	73-110	49.0	33.9	91.5
(<8-μ), μg/l	4	12	2	2.41-6.17	3.11-8.11	1.83-2.15	4.59	5.44	1.99
(<0.45-μ), μg/l	4	12	2	2.33-5.33	2.86-7.43	1.98-2.11	3.96	4.99	2.05
(<0.05-μ), μg/l	4	12	2	1.73-5.21	2.17-7.19	1.72-2.00	3.11	4.51	1.86
In Oil & Grease, μg/l	4	12	2	2.31-4.23	1.38-4.28	1.13-2.14	3.51	2.52	1.64
Carb. Phase, mg/kg	6	12	Δ	0.21-1.75	1.76-4.61	*	0.57	2.97	*
Exch. Phase, mg/kg	6	12	Δ	0.13-0.22	0.20-0.55	*	0.17	0.37	*
Iron									
Slurry, mg/l	6	12	—	1460-4080	863-1450	*	2290	1230	*
Solids, mg/kg	6	11	—	27400-36800	25100-37000	*	32300	31900	*
(<8-μ), μg/l	4	12	2	31.0-750	12.0-283	3.92-4.62	218	95.5	4.27

Parameters	Standard Deviation			F - Value Influent vs. Background W	F - Value Influent vs. Effluent	F - Value Effluent vs. Background W	Loading Influent vs. Background W	Removal Influent vs. Effluent	Impact Effluent vs. Background W
	Influent	Effluent	Background Water						
Carb. Phase, mg/kg	0.072	0.039	*	*	2.50	*	*	$NSD_{1,5}$	*
Exch. Phase, mg/kg	0.004	0.019	*	*	18.8	*	*	$SD_{1,5}$	*
Chromium									
Slurry, mg/l	*	*	*	*	*	*	*	*	*
In Oil & Grease, μg/l	0.281	0.203	*	*	1.92	*	*	$NSD_{1,5}$	*
Carb. Phase, mg/kg	0.178	0.151	*	*	1.39	*	*	$NSD_{1,5}$	*
Exch. Phase, mg/kg	0.058	0.087	*	*	2.66	*	*	$NSD_{1,5}$	*
Copper									
Slurry, mg/l	0.927	0.492	0.169	29.7	3.55	8.34	$NSD_{1,5}$	SD_{5}	$NSD_{1,5}$
Solids, mg/kg	23.6	14.6	26.2	1.23	2.62	3.22	$NSD_{1,5}$	$NSD_{1,5}$	$NSD_{1,5}$
(<8-μ), μg/l	1.66	1.67	0.226	54.8	1.02	55.8	$NSD_{1,5}$	$NSD_{1,5}$	$NSD_{1,5}$
(<0.45-μ), μg/l	1.26	1.66	0.092	197	1.75	345	$NSD_{1,5}$	$NSD_{1,5}$	SD_{5}
(<0.05-μ), μg/l	1.52	1.45	0.198	57.8	1.10	52.8	$NSD_{1,5}$	$NSD_{1,5}$	$NSD_{1,5}$
In Oil & Grease, μg/l	0.832	0.819	0.714	1.36	1.03	1.31	$NSD_{1,5}$	$NSD_{1,5}$	$NSD_{1,5}$
Carb. Phase, mg/kg	0.605	0.737	*	*	1.48	*	*	$NSD_{1,5}$	*
Exch. Phase, mg/kg	0.035	0.113	*	*	13.0	*	*	$SD_{1,5}$	*
Iron									
Slurry, mg/l	959	200	*	*	23.0	*	*	$SD_{1,5}$	*
Solids, mg/kg	3280	3910	*	*	1.42	*	*	$NSD_{1,5}$	*
(<8-μ), μg/l	355	95.3	0.495	514000	13.9	37100	$SD_{1,5}$	$SD_{1,5}$	$SD_{1,5}$

(Continued)

Table 2 (Continued)

Parameters	Number Of Samples: Influent	Number Of Samples: Effluent	Number Of Samples: Background Water	Range: Influent	Range: Effluent	Range: Background Water	Mean: Influent	Mean: Effluent	Mean: Background Water
(<0.45-µ), µg/l	4	12	2	29.4-350	3.5-55.1	1.4-4.2	118	19.6	2.8
(<0.05-µ), µg/l	4	12	2	15.6-310	2.4-32.8	1.2-1.3	102	13.8	1.25
In Oil & Grease, µg/l	4	12	2	82.3-1490	2.07-7.48	1.53-1.81	707	3.77	1.67
Carb. Phase, mg/kg	6	12	Δ	2390-5520	1360-2520	*	3580	1910	*
Exch. Phase, mg/kg	6	12	Δ	0.12-0.89	0.06-0.44	*	0.35	0.15	*
Manganese									
Slurry, mg/l	6	12	1	33.3-53.7	9.7-30.5	•	45.4	20.8	•
Solids, mg/kg	6	11	1	442-1120	274-784	•	716	523	•
(<8-µ), µg/l	4	12	—	4.92-5.22	3.33-5.11	*	5.07	3.87	*
(<0.45-µ), µg/l	4	12	—	4.72-5.00	2.37-4.77	*	4.89	3.72	*
(<0.05-µ), µg/l	4	12	—	4.55-4.82	2.11-4.54	*	4.73	3.58	*
In Oil & Grease, µg/l	4	12	2	1.52-2.11	0.23-1.78	<0.1	1.73	1.37	TRACE
Carb. Phase, mg/kg	6	12	Δ	142-365	66-396	*	246	258	*
Exch. Phase, mg/kg	6	12	Δ	91-185	5.9-128	*	154	43.1	*
Mercury									
Slurry, µg/l	6	12	2	21.0-48.0	17.0-30.0	<0.01	34.5	21.9	TRACE
Solids, mg/kg	6	11	—	0.20-0.80	0.32-0.79	*	0.55	0.59	*
(<8-µ), µg/l	4	12	2	0.23-0.38	0.07-0.33	0.02-0.05	0.28	0.19	0.035
(<0.45-µ), µg/l	4	12	2	0.17-0.32	0.06-0.32	0.02-0.05	0.23	0.16	0.035
(<0.05-µ), µg/l	4	12	2	0.18-0.27	0.06-0.33	<0.01-0.05	0.22	0.17	0.025

Parameters	Standard Deviation: Influent	Standard Deviation: Effluent	Standard Deviation: Background Water	F - Value Influent vs. Background W	F - Value Influent vs. Effluent	F - Value Effluent vs. Background W	Loading Influent vs. Background W	Removal Influent vs. Effluent	Impact Effluent vs. Background W
(<0.45-µ), µg/l	155	16.4	1.98	6160	89.5	68.7	$SD_{1,5}$	$SD_{1,5}$	$NSD_{1,5}$
(<0.05-µ), µg/l	140	11.9	0.071	3900000	139	28100	$SD_{1,5}$	$SD_{1,5}$	$SD_{1,5}$
In Oil & Grease, µg/l	583	1.36	0.198	8510000	184000	46.3	$SD_{1,5}$	$SD_{1,5}$	$NSD_{1,5}$
Carb. Phase, mg/kg	1170	325	*	*	13.0	*	*	$SD_{1,5}$	*
Exch. Phase, mg/kg	0.286	0.118	*	*	5.85	*	*	$SD_{1,5}$	*
Manganese									
Slurry, mg/l	7.33	6.87	•	•	1.13	•	•	$NSD_{1,5}$	•
Solids, mg/kg	285	139	•	•	4.19	•	•	SD_{5}	•
(<8-µ), µg/l	0.145	0.642	*	*	20.5	*	*	SD_{5}	*
(<0.45-µ), µg/l	0.121	0.594	*	*	35.0	*	*	$SD_{1,5}$	*
(<0.05-µ), µg/l	0.120	0.614	*	*	38.0	*	*	$SD_{1,5}$	*
In Oil & Grease, µg/l	0.273	0.414	∿0	∞	2.43	∞	$SD_{1,5}$	$NSD_{1,5}$	$SD_{1,5}$
Carb. Phase, mg/kg	89.5	111	*	*	1.52	*	*	$NSD_{1,5}$	*
Exch. Phase, mg/kg	37.9	51.4	*	*	1.84	*	*	$NSD_{1,5}$	*
Mercury									
Slurry, µg/l	10.1	4.14	∿0	∞	5.95	∞	$SD_{1,5}$	$SD_{1,5}$	$SD_{1,5}$
Solids, mg/kg	0.239	0.147	*	*	2.73	*	*	$NSD_{1,5}$	*
(<8-µ), µg/l	0.071	0.093	0.021	12.5	1.80	22.5	$NSD_{1,5}$	$NSD_{1,5}$	$NSD_{1,5}$
(<0.45-µ), µg/l	0.066	0.088	0.021	10.0	2.00	20.0	$NSD_{1,5}$	$NSD_{1,5}$	$NSD_{1,5}$
(<0.05-µ), µg/l	0.040	0.087	0.035	2.00	4.00	8.00	$NSD_{1,5}$	$NSD_{1,5}$	$NSD_{1,5}$

(Continued)

Table 2 (Continued)

Parameters	Number Of Samples: Influent	Number Of Samples: Effluent	Number Of Samples: Background Water	Range: Influent	Range: Effluent	Range: Background Water	Mean: Influent	Mean: Effluent	Mean: Background Water
Nickel									
Slurry, mg/l	6	9	2	1.27-3.11	0.44-0.81	0.002-0.006	1.83	0.60	0.004
Solids, mg/kg	6	8	—	12.8-32.8	11.3-23.5	*	24.5	16.9	*
(<8-µ), µg/l	4	12	2	7.32-9.76	5.42-10.43	1.83-5.11	8.44	7.79	3.47
(<0.45-µ), µg/l	4	12	2	6.87-8.32	5.23-9.51	1.7-4.9	7.66	7.08	3.3
(<0.05-µ), µg/l	4	12	2	6.31-8.30	4.95-8.75	1.8-4.23	7.54	6.55	3.05
In Oil & Grease, µg/l	4	12	2	4.14-5.53	1.15-6.05	<0.01	4.54	3.74	TRACE
Carb. Phase, mg/kg	6	12	Δ	0.86-2.44	1.22-2.72	*	1.63	1.79	*
Exch. Phase, mg/kg	6	12	Δ	0.08-0.23	0.04-0.38	*	0.128	0.252	*
Lead									
Slurry, mg/l	6	12	2	3.52-6.81	1.70-8.83	0.37-0.52	5.22	3.40	0.45
Solids, mg/kg	6	11	2	61.4-104	46.8-102	74-123	77.1	76.7	98.5
(<8-µ), µg/l	4	12	2	6.42-7.31	3.88-5.83	1.13-1.77	6.54	4.65	[illegible]
(<0.45-µ), µg/l	4	12	2	5.31-6.83	3.72-4.89	1.11-1.72	6.15	4.30	1.42
(<0.05-µ), µg/l	4	12	2	4.17-6.53	3.22-4.75	0.92-1.17	5.49	3.85	1.05
In Oil & Grease, µg/l	4	12	2	2.38-5.27	0.64-1.41	<0.1	3.87	0.97	TRACE
Carb. Phase, mg/kg	6	12	Δ	1.25-2.71	1.18-2.68	*	2.19	1.71	*
Exch. Phase, mg/kg	6	12	Δ	0.05-0.10	0.03-0.17	*	0.07	0.11	*

Parameters	Standard Deviation: Influent	Standard Deviation: Effluent	Standard Deviation: Background Water	F - Value Influent vs. Background W	F - Value Influent vs. Effluent	F - Value Effluent vs. Background W	Loading Influent vs. Background W	Removal Influent vs. Effluent	Impact Effluent vs. Background W
Nickel									
Slurry, mg/l	0.687	0.142	0.003	59000	23.6	2500	$SD_{1,5}$	$SD_{1,5}$	SD_5
Solids, mg/kg	7.31	4.39	*	*	2.77	*	*	$NSD_{1,5}$	*
(<8-µ), µg/l	1.01	1.60	2.32	5.32	2.56	2.10	$NSD_{1,5}$	$NSD_{1,5}$	$NSD_{1,5}$
(<0.45-µ), µg/l	0.769	1.25	2.26	8.68	2.64	3.28	$NSD_{1,5}$	$NSD_{1,5}$	$NSD_{1,5}$
(<0.05-µ), µg/l	0.934	1.10	1.72	3.38	1.39	2.44	$NSD_{1,5}$	$NSD_{1,5}$	$NSD_{1,5}$
In Oil & Grease, µg/l	0.664	1.65	~0	∞	6.20	∞	$SD_{1,5}$	$NSD_{1,5}$	$SD_{1,5}$
Carb. Phase, mg/kg	0.606	0.434	*	*	1.95	*	*	$NSD_{1,5}$	*
Exch. Phase, mg/kg	0.055	0.116	*	*	4.33	*	*	$NSD_{1,5}$	*
Lead									
Slurry, mg/l	1.26	1.83	0.106	159	2.11	336	$NSD_{1,5}$	$NSD_{1,5}$	SD_5
Solids, mg/kg	15.1	19.0	34.7	5.28	1.59	3.33	$NSD_{1,5}$	$NSD_{1,5}$	$NSD_{1,5}$
(<8-µ), µg/l	0.752	0.612	0.452	2.76	1.51	1.82	$NSD_{1,5}$	$NSD_{1,5}$	$NSD_{1,5}$
(<0.45-µ), µg/l	0.682	0.511	0.431	2.50	1.78	1.40	$NSD_{1,5}$	$NSD_{1,5}$	$NSD_{1,5}$
(<0.05-µ), µg/l	1.03	0.635	0.177	35.4	2.63	13.4	$NSD_{1,5}$	$NSD_{1,5}$	$NSD_{1,5}$
In Oil & Grease, µg/l	1.26	0.246	~0	∞	26.3	∞	$SD_{1,5}$	$SD_{1,5}$	$SD_{1,5}$
Carb. Phase, mg/kg	0.601	0.572	*	*	1.10	*	*	$NSD_{1,5}$	*
Exch. Phase, mg/kg	0.021	0.034	*	*	2.00	*	*	$NSD_{1,5}$	*

(Continued)

Table 2 (Continued)

Parameters	Number Of Samples Influent	Effluent	Background Water	Range Influent	Effluent	Background Water	Mean Influent	Effluent	Background Water
Selenium									
Slurry, mg/l	6	12	—	2.68-3.77	0.98-2.63	*	3.10	1.89	*
Solids, mg/kg	6	11	—	30.9-70.2	28.7-71.8	*	47.9	48.9	*
(<8-μ),μg/l	3	12	2	1.71-4.51	1.83-4.73	0.47-0.59	3.47	2.85	0.53
(<0.45-μ),μg/l	3	12	2	1.61-4.41	1.69-3.80	0.50-0.61	3.31	2.62	0.56
(<0.05-μ),μg/l	1	12	2	•	1.47-3.34	0.47-0.51	•	2.39	0.49
Titanium									
Slurry,mg/l	6	12	2	3.87-6.71	2.23-3.71	<0.1	5.24	2.74	TRACE
Solids,mg/kg	6	11	—	56.8-108.6	50.2-99.7	*	78.6	74.2	*
(<8-μ),μg/l	4	12	2	3.83-5.38	2.13-4.52	<0.1	4.33	3.17	TRACE
(<0.45-μ),μg/l	4	12	2	3.87-5.22	1.95-4.33	<0.1	4.32	3.04	TRACE
(<0.05-μ),μg/l	2	12	2	3.83-5.14	1.72-4.27	<0.1	4.49	2.88	TRACE
In Oil & Grease, μg/l	4	12	—	0.55-0.72	<0.1-0.62	*	0.66	0.12	*
Vanadium									
Slurry,mg/l	6	12	—	3.17-4.33	1.15-4.13	*	3.68	2.02	*
Solids,mg/kg	6	11	—	39.0-79.8	31.9-77.6	*	56.7	50.2	*
(<8-μ), μg/l	4	12	2	6.17-9.73	2.47-6.43	<0.05	7.57	4.12	TRACE
(<0.45-μ),μg/l	4	12	2	5.87-8.17	2.31-6.27	<0.05	6.96	4.02	TRACE
(<0.05-μ),μg/l	4	12	2	5.21-8.23	1.97-6.03	<0.05	6.58	3.79	TRACE
In Oil & Grease, μg/l	4	12	—	1.38-2.50	<0.05-2.03	*	1.78	0.93	*

Parameters	Standard Deviation Influent	Effluent	Background Water	F - Value Influent vs. Background W	F - Value Influent vs. Effluent	F - Value Effluent vs. Background W	Loading Influent vs. Background W	Removal Influent vs. Effluent	Impact Effluent vs. Background W
Selenium									
Slurry, mg/l	0.429	0.561	*	*	1.75	*	*	$NSD_{1,5}$	*
Solids, mg/kg	15.3	14.2	*	*	1.17	*	*	$NSD_{1,5}$	*
(<8-μ),μg/l	1.53	0.853	0.085	334	3.21	104	SD_5	$NSD_{1,5}$	$NSD_{1,5}$
(<0.45-μ),μg/l	1.49	0.712	0.078	372	4.37	85	SD_5	SD_5	$NSD_{1,5}$
(<0.05-μ),μg/l	•	0.632	0.028	•	•	499	•	•	SD_5
Titanium									
Slurry,mg/l	1.19	0.467	~ 0	∞	6.50	∞	$SD_{1,5}$	$SD_{1,5}$	$SD_{1,5}$
Solids,mg/kg	20.1	17.1	*	*	1.38	*	*	$NSD_{1,5}$	*
(<8-μ),μg/l	0.716	0.734	~ 0	∞	1.05	∞	$SD_{1,5}$	$NSD_{1,5}$	$SD_{1,5}$
(<0.45-μ),μg/l	0.618	0.748	~ 0	∞	1.47	∞	$SD_{1,5}$	$NSD_{1,5}$	$SD_{1,5}$
(<0.05-μ),μg/l	0.926	0.778	~ 0	∞	1.41	∞	$SD_{1,5}$	$NSD_{1,5}$	$SD_{1,5}$
In Oil & Grease, μg/l	0.075	0.199	*	*	6.66	*	*	$NSD_{1,5}$	*
Vanadium									
Slurry,mg/l	0.436	0.800	*	*	3.39	*	*	$NSD_{1,5}$	*
Solids,mg/kg	17.4	12.9	*	*	1.81	*	*	$NSD_{1,5}$	*
(<8-μ), μg/l	1.60	1.27	~ 0	∞	1.60	∞	$SD_{1,5}$	$NSD_{1,5}$	$SD_{1,5}$
(<0.45-μ),μg/l	1.00	1.29	~ 0	∞	1.66	∞	$SD_{1,5}$	$NSD_{1,5}$	$SD_{1,5}$
(<0.05-μ),μg/l	1.33	1.36	~ 0	∞	1.06	∞	$SD_{1,5}$	$NSD_{1,5}$	$SD_{1,5}$
In Oil & Grease, μg/l	0.499	0.542	*	*	1.18	*	*	$NSD_{1,5}$	*

(Continued)

Table 2 (Continued)

Parameters	Number Of Samples: Influent	Number Of Samples: Effluent	Number Of Samples: Background Water	Range: Influent	Range: Effluent	Range: Background Water	Mean: Influent	Mean: Effluent	Mean: Background Water
Carb.Phase,mg/kg	6	12	Δ	3.30-5.30	<0.10-1.60	*	4.23	0.37	*
Exch.Phase,mg/kg	6	12	Δ	<0.1	<0.1	*	TRACE	TRACE	*
Zinc									
Slurry,mg/l	6	12	2	10.5-22.9	7.3-14.1	1.12-1.13	16.4	10.7	1.13
Solids,mg/kg	6	11	—	206-285	198-307	*	237	272	*
(<8-μ),μg/l	4	12	2	<0.1-3.6	0.11-3.68	0.33-0.52	1.55	1.19	0.43
(<0.45-μ),μg/l	4	12	2	<0.1-1.13	0.29-1.95	0.63-1.68	0.28	1.11	1.16
(<0.05-μ),μg/l	4	12	2	<0.1-1.12	0.17-1.93	0.56-1.32	0.28	1.04	0.94
In Oil & Grease, μg/l	4	12	2	2.73-3.72	<0.1-2.11	0.62-0.85	3.28	1.12	0.74
Carb.Phase,mg/kg	6	12	Δ	22.3-80.8	46.7-87.3	*	44.2	55.2	*
Exch.Phase,mg/kg	6	12	Δ	0.08-1.3	3.0-11.4	*	0.29	5.55	*
Chlorinated Hydrocarbons OP' DDD Slurry,mg/l	3	3	1	0.053-0.486	0.040-0.171	·	0.272	0.111	·
PP' DDD Slurry,mg/l	3	3	1	0.162-0.874	0.073-0.186	·	0.466	0.140	·
OP' DDE Slurry,mg/l	3	3	1	0.066-0.342	0.020-0.063	·	0.162	0.040	·

Parameters	Standard Deviation: Influent	Standard Deviation: Effluent	Standard Deviation: Background Water	F - Value Influent vs. Background W	F - Value Influent vs. Effluent	F - Value Effluent vs. Background W	Loading Influent vs. Background W	Removal Influent vs. Effluent	Impact Effluent vs. Background W
Carb.Phase,mg/kg	0.784	0.596	*	*	1.73	*	*	$NSD_{1,5}$	*
Exch.Phase,mg/kg	∿0	∿0	*	*	IND	*	*	ND	*
Zinc									
Slurry,mg/l	4.95	2.37	0.007	490000	4.35	112000	$SD_{1,5}$	SD_5	$SD_{1,5}$
Solids,mg/kg	27.2	38.0	*	*	1.94	*	*	$NSD_{1,5}$	*
(<8-μ),μg/l	1.50	1.14	0.134	125	1.74	71.8	$NSD_{1,5}$	$NSD_{1,5}$	$NSD_{1,5}$
(<0.45-μ),μg/l	0.565	0.643	0.742	1.72	1.29	1.34	$NSD_{1,5}$	$NSD_{1,5}$	$NSD_{1,5}$
(<0.05-μ),μg/l	0.560	0.583	0.537	1.12	1.08	1.21	$NSD_{1,5}$	$NSD_{1,5}$	$NSD_{1,5}$
In Oil & Grease, μg/l	0.435	0.503	0.163	7.30	1.33	9.73	$NSD_{1,5}$	$NSD_{1,5}$	$NSD_{1,5}$
Carb.Phase,mg/kg	22.1	11.0	*	*	4.00	*	*	SD_5	*
Exch.Phase,mg/kg	0.493	3.03	*	*	37.7	*	*	$SD_{1,5}$	*
Chlorinated Hydrocarbons OP' DDD Slurry,mg/l	0.216	0.066	·	·	11.8	·	·	$NSD_{1,5}$	·
PP' DDD Slurry,mg/l	0.367	0.059	·	·	37.8	·	·	SD_5	·
OP' DDE Slurry,mg/l	0.155	0.022	·	·	51.2	·	·	SD_5	·

(Continued)

Table 2 (Continued)

Parameters	Number Of Samples			Range			Mean		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water	Influent	Effluent	Background Water
PP' DDE Slurry, mg/l	3	3	1	0.233-0.828	0.059-0.171	•	0.442	0.109	•
OP' DDT Slurry, mg/l	3	3	1	0.047-0.283	<0.001	•	0.186	TRACE	•
PP' DDT Slurry, mg/l	3	3	1	0.182-0.874	<0.001	•	0.472	TRACE	•
Total DDT Slurry, mg/l	3	3	1	0.743-3.39	0.192-0.590	•	2.01	0.400	•

Parameters	Standard Deviation			F - Value Influent vs. Background W	F - Value Influent vs. Effluent	F - Value Effluent vs. Background W	Loading Influent vs. Background W	Removal Influent vs. Effluent	Impact Effluent vs. Background W
	Influent	Effluent	Background Water						
PP' DDE Slurry, mg/l	0.334	0.057	•	•	37.0	•	•	SD_5	•
OP' DDT Slurry, mg/l	0.123	∿0	•	•	∞	•	•	$SD_{1,5}$	•
PP' DDT Slurry, mg/l	0.359	∿0	•	•	∞	•	•	$SD_{1,5}$	•
Total DDT Slurry, mg/l	1.33	0.199	•	•	45.1	•	•	SD_5	•

(Continued)

Table 2 (Concluded)

Parameters	Number Of Samples: Influent	Number Of Samples: Effluent	Number Of Samples: Background Water	Range: Influent	Range: Effluent	Range: Background Water	Mean: Influent	Mean: Effluent	Mean: Background Water
Aroclor 1242 Slurry, mg/l	3	3	1	0.370-1.26	0.030-0.040	•	0.806	0.033	•
Aroclor 1254 Slurry, mg/l	3	3	1	0.350-0.600	0.010-0.020	•	0.443	0.013	•
Aroclor 1260 Slurry, mg/l	3	3	1	0.110-0.180	0.001-0.002	•	0.136	0.001	•
Total PCB Slurry, mg/l	3	3	1	0.830-2.04	0.041-0.052	•	1.38	0.048	•

Parameters	Standard Deviation: Influent	Standard Deviation: Effluent	Standard Deviation: Background Water	F - Value Influent vs. Background W	F - Value Influent vs. Effluent	F - Value Effluent vs. Background W	Loading Influent vs. Background W	Removal Influent vs. Effluent	Impact Effluent vs. Background W
Aroclor 1242 Slurry, mg/l	0.445	0.005	•	•	6000	•	•	$SD_{1,5}$	•
Aroclor 1254 Slurry, mg/l	0.136	0.006	•	•	545	•	•	$SD_{1,5}$	•
Aroclor 1260 Slurry, mg/l	0.038	0.001	•	•	467	•	•	$SD_{1,5}$	•
Total PCB Slurry, mg/l	0.611	0.006	•	•	10400	•	•	$SD_{1,5}$	•

TABLE 3

Statistical Character Of Background Water, Influent and Effluent Samples For Grassy Island, Detroit, Michigan - A Site Specific Analysis

Parameters	Number Of Samples: Influent	Number Of Samples: Effluent	Number Of Samples: Background Water	Range: Influent	Range: Effluent	Range: Background Water	Mean: Influent	Mean: Effluent	Mean: Background Water
PH									
Slurry	9	9	3	7.0-7.3	7.1-7.3	7.0	7.1	7.2	7.0
(<0.45-μ)	6	6	1	8.0-8.4	8.0-8.6	·	8.3	8.3	·
Salinity, $^{0}/_{00}$									
Slurry	9	9	3	0.2-0.5	0.2-0.5	0.2	0.3	0.4	0.2
(<0.45-μ)	6	6	1	<0.1	<0.1	·	TRACE	TRACE	·
Conductivity, in mMhos									
Slurry	9	9	3	0.35-0.37	0.70-0.75	0.28-0.30	0.36	0.71	0.29
(<0.45-μ)	6	6	1	0.08-0.13	0.057-0.08	·	0.11	0.07	·
Water Temp, °C	9	9	3	23.0-25.0	23.0-25.0	29.0-29.0	24.3	24.0	29.0
Dry Weight, %	6	6	1	13.9-24.0	0.03-0.10	·	18.6	0.06	·
D.O., mg/l	9	9	3	7.1-7.6	6.9-7.6	7.0	7.4	7.3	7.0

Parameters	Standard Deviation: Influent	Standard Deviation: Effluent	Standard Deviation: Background Water	F - Value Influent vs. Background W	F - Value Influent vs. Effluent	F - Value Effluent vs. Background W	Loading Influent vs. Background W	Removal Influent vs. Effluent	Impact Effluent vs. Background W
PH									
Slurry	0.106	0.074	0	∞	2.20	∞	$SD_{1,5}$	$NSD_{1,5}$	$SD_{1,5}$
(<0.45-μ)	0.155	0.216	·	·	1.95	·	·	$NSD_{1,5}$	·
Salinity, $^{0}/_{00}$									
Slurry	0.129	0.132	0	∞	1.06	∞	$SD_{1,5}$	$NSD_{1,5}$	$SD_{1,5}$
(<0.45-μ)	∿0	∿0	·	·	IND	·	·	ND	·
Conductivity, in mMhos									
Slurry	0.010	0.017	0.01	1.0	3.00	3.00		$NSD_{1,5}$	
(<0.45-μ)	0.020	0.009	·	·	7.14	·	·	SD_5	·
Water Temp, °C	0.666	0.866	0	∞	1.70	∞	$SD_{1,5}$	$NSD_{1,5}$	$SD_{1,5}$
Dry Weight, %	3.46	0.032	·	·	12000	·	·	$SD_{1,5}$	·
D.O., mg/l	0.196	0.283	0	∞	2.00	∞	$SD_{1,5}$	$NSD_{1,5}$	$SD_{1,5}$

(Continued)

IND. - Indeterminate.
(—) - Not Determined (Insufficient Sample or Sample Destroyed In Transit).
(Δ) - Not Enough Solids To Perform Analysis.
(*) - Cannot Ascertain Since Not Determined or Not Enough Solids to Perform Analysis.
(·) - Cannot Ascertain Since Only One Sample Analyzed.
$SD_{1,5}$ - Significant Difference at $P \leq 0.05$ and $P < 0.01$.
$NSD_{1,5}$ - No Significant Difference at Either $P \leq 0.05$ or $P \leq 0.01$.
SD_5 - Significant Difference at $P \leq 0.05$ only.
ND - No Difference (Difficult to Decide on Significance of Difference Since Values Compared are at Trace Levels).

Table 3 (Continued)

Parameters	Number Of Samples Influent	Number Of Samples Effluent	Number Of Samples Background Water	Range Influent	Range Effluent	Range Background Water	Mean Influent	Mean Effluent	Mean Background Water
Alkalinity, mg/l as $CaCO_3$ (<0.45-μ)	6	6	1	310-610	198-290	•	505	244	•
Chloride, mg/l (<0.45-μ)	6	5	1	40.7-67.8	44.9-53.9	•	50.6	47.9	•
Cation Exchange Capacity, meq/l	6	Δ	Δ	36.2-162	*	*	69.2	*	*
Acid Soluble Sulfide, mg/l	6	6	1	31.2-48.9	<0.1-0.40	•	38.4	0.20	•
Total-C, mg/l									
Slurry	6	6	1	155-276	85.0-101	•	214	97.0	•
(<8-μ)	6	6	1	133-248	60.0-81.0	•	166	68.0	•
(<0.45-μ)	6	6	1	124-224	54.0-75.0	•	154	64.0	•
(<0.05-μ)	6	5	1	106-170	52.0-70.0	•	130	59.0	•
Organic-C, mg/l Slurry	6	6	1	35.0-86.0	19.0-29.0	•	63.0	24.0	•

Parameters	Standard Deviation Influent	Standard Deviation Effluent	Standard Deviation Background Water	F - Value Influent vs. Background W	F - Value Influent vs. Effluent	F - Value Effluent vs. Background W	Loading Influent vs. Background W	Removal Influent vs. Effluent	Impact Effluent vs. Background W
Alkalinity, mg/l as $CaCO_3$ (<0.45-μ)	109	37.9	•	•	8.31	•	•	SD_s	•
Chloride, mg/l (<0.45-μ)	13.5	3.62	•	•	13.9	•	•	SD_s	•
Cation Exchange Capacity, meq/l	48.6	*	*	*	*	*	*	*	*
Acid Soluble Sulfide, mg/l	6.07	0.176	•	•	1230	•	•	$SD_{1,s}$	•
Total-C, mg/l									
Slurry	44.4	5.96	•	•	55.6	•	•	$SD_{1,s}$	•
(<8-μ)	42.8	8.41	•	•	25.9	•	•	$SD_{1,s}$	•
(<0.45-μ)	36.6	8.39	•	•	19.1	•	•	$SD_{1,s}$	•
(<0.05-μ)	23.8	8.17	•	•	8.45	•	•	SD_s	•
Organic-C, mg/l Slurry	17.5	3.56	•	•	24.1	•	•	$SD_{1,s}$	•

(Continued)

Table 3 (Continued)

Parameters	Number Of Samples Influent	Number Of Samples Effluent	Number Of Samples Background Water	Range Influent	Range Effluent	Range Background Water	Mean Influent	Mean Effluent	Mean Background Water
(<8-μ)	6	6	1	13.0-64.0	5.0-34.0	•	27.0	20.0	•
(<0.45-μ)	6	6	1	13.0-53.0	2.0-26.0	•	24.0	11.0	•
(<0.05-μ)	6	5	1	5.0-47.0	8.0-29.0	•	19.0	14.0	•
Oil & Grease, mg/l									
Slurry	6	4	1	3080-8420	8-28	•	5260	15	•
NH_3-N, mg/l									
Slurry	2	3	1	70.2-97.3	13.8-14.8	•	83.8	14.2	•
(<8-μ)	3	3	1	1.90-85.2	13.1-13.2	•	40.7	13.2	•
(<0.45-μ)	3	3	1	1.60-81.5	12.4-13.9	•	38.5	13.0	•
(<0.05-μ)	2	1	1	1.20-80.7	•	•	40.9	•	•
Organic-N, mg/l									
Slurry	3	3	1	2.39-118	2.23-2.87	•	60.5	2.57	•
(<8-μ)	3	3	1	1.08-12.1	1.60-2.20	•	6.77	1.98	•
(<0.45-μ)	3	3	1	0.77-11.1	0.83-1.83	•	5.82	1.47	•
(<0.05-μ)	2	1	1	0.24-11.0	•	•	5.62	•	•
NO_3-N, mg/l									
(<0.45-μ)	3	3	1	0.18-0.22	0.10-0.12	•	0.20	0.11	•
NO_2-N, mg/l									
(<0.45-μ)	3	3	1	<0.01	<0.01	•	TRACE	TRACE	•

Parameters	Standard Deviation Influent	Standard Deviation Effluent	Standard Deviation Background Water	F - Value Influent vs. Background W	F - Value Influent vs. Effluent	F - Value Effluent vs. Background W	Loading Influent vs. Background W	Removal Influent vs. Effluent	Impact Effluent vs. Background W
(<8-μ)	19.6	10.2	•	•	3.69	•	•	$NSD_{1,5}$	•
(<0.45-μ)	15.1	8.73	•	•	2.98	•	•	$NSD_{1,5}$	•
(<0.05-μ)	14.8	8.74	•	•	2.88	•	•	$NSD_{1,5}$	•
Oil & Grease, mg/l									
Slurry	1920	8.91	•	•	46500	•	•	$SD_{1,5}$	•
NH_3-N, mg/l									
Slurry	19.2	0.529	•	•	1320	•	•	$SD_{1,5}$	•
(<8-μ)	42.0	0.060	•	•	587000	•	•	$SD_{1,5}$	•
(<0.45-μ)	40.3	0.777	•	•	2690	•	•	$SD_{1,5}$	•
(<0.05-μ)	56.2	•	•	•	•	•	•	•	•
Organic-N, mg/l									
Slurry	57.8	0.321	•	•	32500	•	•	$SD_{1,5}$	•
(<8-μ)	5.52	0.333	•	•	274	•	•	$SD_{1,5}$	•
(<0.45-μ)	5.17	0.555	•	•	86.2	•	•	SD_5	•
(<0.05-μ)	7.61	•	•	•	•	•	•	•	•
NO_3-N, mg/l									
(<0.45-μ)	0.020	0.010	•	•	4.00	•	•	$NSD_{1,5}$	•
NO_2-N, mg/l									
(<0.45-μ)	~0	~0	•	•	IND	•	•	ND	•

(Continued)

Table 3 (Continued)

Parameters	Number Of Samples: Influent	Number Of Samples: Effluent	Number Of Samples: Background Water	Range: Influent	Range: Effluent	Range: Background Water	Mean: Influent	Mean: Effluent	Mean: Background Water
Total P, mg/l									
Slurry	3	3	1	9.38-230	0.06-0.19	•	129	0.15	•
(<8-μ)	3	3	1	<0.01	<0.01	•	TRACE	TRACE	•
(<0.45-μ)	3	3	1	<0.01	<0.01	•	TRACE	TRACE	•
(<0.05-μ)	3	3	1	<0.01	<0.01	•	TRACE	TRACE	•
Sodium									
Slurry,mg/l	2	—	—	225-245	*	*	235	*	*
(<8-μ),mg/l	1	4	1		26.5-30.5	•	•	28.8	•
(<0.45-μ),mg/l	3	3	1	23.5-25.0	23.5-32.0	•	24.5	28.7	•
(<0.05-μ),mg/l	2	6	1	20.5-21.0	18.0-29.0	•	20.8	22.8	•
Potassium									
Slurry, mg/l	4	6	—	492-1320	158-452	*	886	345	*
Solids,mg/kg	4	Δ	—	2450-6940	*	*	4670	*	*
(<8-μ),mg/l	4	6	—	135-173	73.1-168	*	148	123	*
(<0.45-μ),mg/l	4	6	—	126-167	78.5-156	*	38	118	*
(<0.05-μ),mg/l	4	6	—	118-152	75.9-152	*	129	113	*
Calcium									
Slurry, mg/l	4	6	1	55.7-72.8	28.3-43.8	•	62.4	35.0	•
Solids,mg/kg	4	Δ	Δ	312-407	*	*	342	*	*
(<8-μ),mg/l	4	6	1	43.9-57.2	25.2-36.4	•	49.8	30.8	•
(<0.45-μ),mg/l	4	6	1	42.7-56.3	22.3-35.6	•	48.8	29.0	•
(<0.05-μ),mg/l	4	6	1	41.6-52.8	21.4-33.6	•	46.4	27.2	•

Parameters	Standard Deviation: Influent	Standard Deviation: Effluent	Standard Deviation: Background Water	F - Value Influent vs. Background W	F - Value Influent vs. Effluent	F - Value Effluent vs. Background W	Loading Influent vs. Background W	Removal Influent vs. Effluent	Impact Effluent vs. Background W
Total P, mg/l									
Slurry	112	0.075	•	•	2,070,000	•	•	$SD_{1,5}$	•
(<8-μ)	~ 0	~ 0	•	•	IND.	•	•	ND	•
(<0.45-μ)	~ 0	~ 0	•	•	IND.	•	•	ND	•
(<0.05-μ)	~ 0	~ 0	•	•	IND.	•	•	ND	•
Sodium									
Slurry,mg/l	14.1	*	*	*	*	*	*	*	*
(<8-μ),mg/l	•	1.66	•	•	•	•	•	•	•
(<0.45-μ),mg/l	0.866	4.54	•	•	27.4	•	•	SD_5	•
(<0.05-μ),mg/l	0.354	3.82	•	•	117	•	•	$NSD_{1,5}$	•
Potassium									
Slurry, mg/l	441	105	*	*	17.7	*	*	$SD_{1,5}$	*
Solids,mg/kg	2210	*	*	*	*	*	*	*	*
(<8-μ),mg/l	17.3	33.6	*	*	3.77	*	*	$NSD_{1,5}$	*
(<0.45-μ),mg/l	19.3	29.0	*	*	2.24	*	*	$NSD_{1,5}$	*
(<0.05-μ),mg/l	15.5	27.1	*	*	3.05	*	*	$NSD_{1,5}$	*
Calcium									
Slurry, mg/l	7.39	6.35	•	•	1.36	•	•	$NSD_{1,5}$	•
Solids,mg/kg	45.0	*	*	*	*	*	*	*	*
(<8-μ),mg/l	6.71	4.69	•	•	2.06	•	•	$NSD_{1,5}$	•
(<0.45-μ),mg/l	6.66	5.28	•	•	1.59	•	•	$NSD_{1,5}$	•
(<0.05-μ),mg/l	5.59	4.91	•	•	1.29	•	•	$NSD_{1,5}$	•

(Continued)

Table 3 (Continued)

Parameters	Number Of Samples			Range			Mean		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water	Influent	Effluent	Background Water
Magnesium									
Slurry, mg/l	4	6	1	137-273	124-183	•	174	156	•
Solids, mg/kg	4	Δ	Δ	650-1440	*	*	948	*	*
(<8-μ), mg/l	4	6	1	53.5-179	29.3-55.1	•	87.8	38.2	•
(<0.45-μ),mg/l	4	6	1	40.5-176	29.7-52.1	•	79.6	36.9	•
(<0.05-μ),mg/l	4	6	1	33.8-171	21.0-43.6	•	72.0	32.9	•
Arsenic									
Slurry, mg/l	—	—	—	*	*	*	*	*	*
In Oil & Grease, μg/l	4	6	—	0.83-0.93	0.37-0.78	*	0.87	0.59	*
Carb.Phase,mg/kg	6	Δ	Δ	0.32-0.84	*	*	0.52	*	*
Exch.Phase,mg/kg	6	Δ	Δ	0.12-0.17	*	*	0.14	*	*
Cadmium									
Slurry, μg/l	6	5	1	210-710	1.15-2.89	•	435	1.86	•
Solids, mg/kg	6	Δ	Δ	1.40-3.44	*	*	2.47	*	*
(<8-μ), μg/l	4	6	1	2.81-11.0	0.42-1.23	•	5.13	0.89	•
(<0.45-μ), μg/l	4	6	1	2.75-7.87	0.63-1.98	•	4.33	0.94	•
(<0.05-μ), μg/l	4	6	1	2.32-6.33	0.31-1.16	•	3.67	0.71	•
In Oil & Grease, μg/l	4	6	1	<0.01-0.21	<0.01-0.44	•	0.13	0.21	•
Carb.Phase,mg/kg	6	Δ	Δ	0.090-0.310	*	*	0.150	*	*
Exch.Phase,mg/kg	6	Δ	Δ	0.017-0.034	*	*	0.025	*	*

Parameters	Standard Deviation			F - Value Influent vs. Background W	F - Value Influent vs. Effluent	F - Value Effluent vs. Background W	Loading Influent vs. Background W	Removal Influent vs. Effluent	Impact Effluent vs. Background W
	Influent	Effluent	Background Water						
Magnesium									
Slurry, mg/l	67.4	20.0	•	•	11.4	•	•	SD_S	•
Solids, mg/kg	342	*	*	*	*	*	*	*	*
(<8-μ), mg/l	61.1	9.46	•	•	41.8	•	•	$SD_{I,S}$	•
(<0.45-μ),mg/l	64.6	7.97	•	•	65.7	•	•	$SD_{I,S}$	•
(<0.05-μ),mg/l	66.2	7.32	•	•	81.9	•	•	$SD_{I,S}$	•
Arsenic									
Slurry, mg/l	*	*	*	*	*	*	*	*	*
In Oil & Grease, μg/l	0.045	0.171	*	*	15.0	*	*	SD_S	*
Carb.Phase,mg/kg	0.199	*	*	*	*	*	*	*	*
Exch.Phase,mg/kg	0.018	*	*	*	*	*	*	*	*
Cadmium									
Slurry, μg/l	180	0.769	•	•	55100	•	•	$SD_{I,S}$	•
Solids, mg/kg	1.02	*	*	*	*	*	*	*	*
(<8-μ), μg/l	3.92	0.290	•	•	178	•	•	$SD_{I,S}$	•
(<0.45-μ), μg/l	2.40	0.558	•	•	18.4	•	•	$SD_{I,S}$	•
(<0.05-μ), μg/l	1.86	0.288	•	•	41.4	•	•	$SD_{I,S}$	•
In Oil & Grease, μg/l	0.088	0.197	•	•	5.00	•	•	$NSD_{I,S}$	•
Carb.Phase,mg/kg	0.084	*	*	*	*	*	*	*	*
Exch.Phase,mg/kg	0.006	*	*	*	*	*	*	*	*

(Continued)

Table 3 (Continued)

Parameters	Number Of Samples Influent	Effluent	Background Water	Range Influent	Effluent	Background Water	Mean Influent	Effluent	Background Water
Chromium									
Slurry, mg/l	—	—	—	*	*	*	*	*	*
In Oil & Grease, µg/l	4	6	—	0.52-0.77	0.53-0.82	*	0.66	0.69	*
Carb.Phase, mg/kg	6	Δ	Δ	9.23-16.4	*	*	12.7	*	*
Exch.Phase, mg/kg	6	Δ	Δ	0.11-0.14	*	*	0.13	*	*
Copper									
Slurry, mg/l	6	6	1	18.7-243	1.14-1.93	•	93.8	1.62	•
Solids, mg/kg	6	Δ	Δ	88.0-160	*	*	123	*	*
(<8-µ), µg/l	4	6	1	9.1-17.4	3.0-8.7	•	12.2	5.61	•
(<0.45-µ), µg/l	4	6	1	8.2-15.2	2.9-8.2	•	10.5	5.07	•
(<0.05-µ), µg/l	4	6	1	7.3-14.9	1.7-7.5	•	9.6	4.43	•
In Oil & Grease, µg/l	4	6	1	4.32-5.15	2.78-4.07	•	4.72	3.46	•
Carb.Phase, mg/kg	6	Δ	Δ	0.54-0.89	*	*	*	*	*
Exch.Phase, mg/kg	6	Δ	Δ	0.12-0.25	*	*	0.19	*	*
Iron									
Slurry, mg/l	6	6	1	4870-6830	37.8-50.1	•	5620	46.8	•
Solids, mg/kg	6	Δ	Δ	25500-38200	*	*	30700	*	*
(<8-µ), µg/l	4	6	1	532-845	2.2-10.1	•	691	6.44	•
(<0.45-µ), µg/l	4	6	1	29-302	2.7-12.7	•	136	5.20	•
(<0.05-µ), µg/l	4	6	1	15.7-157	1.6-8.5	•	87.8	4.00	•

Parameters	Standard Deviation Influent	Effluent	Background Water	F - Value Influent vs. Background W	F - Value Influent vs. Effluent	F - Value Effluent vs. Background W	Loading Influent vs. Background W	Removal Influent vs. Effluent	Impact Effluent vs. Background W
Chromium									
Slurry, mg/l	*	*	*	*	*	*	*	*	*
In Oil & Grease, µg/l	0.112	0.099	*	*	1.44	*	*	$NSD_{1,5}$	*
Carb.Phase, mg/kg	2.63	*	*	*	*	*	*	*	*
Exch.Phase, mg/kg	0.014	*	*	*	*	*	*	*	*
Copper									
Slurry, mg/l	112	0.304	•	•	139000	•	•	$SD_{1,5}$	•
Solids, mg/kg	23.9	*	*	*	*	*	*	*	*
(<8-µ), µg/l	3.67	2.38	•	•	2.37	•	•	$NSD_{1,5}$	•
(<0.45-µ), µg/l	3.20	2.11	•	•	2.34	•	•	$NSD_{1,5}$	•
(<0.05-µ), µg/l	3.55	2.25	•	•	2.47	•	•	$NSD_{1,5}$	•
In Oil & Grease, µg/l	0.382	0.477	•	•	1.55	•	•	$NSD_{1,5}$	•
Carb.Phase, mg/kg	0.118	*	*	*	*	*	*	*	*
Exch.Phase, mg/kg	0.051	*	*	*	*	*	*	*	*
Iron									
Slurry, mg/l	770	4.74	•	•	2660	•	•	$SD_{1,5}$	•
Solids, mg/kg	4960	*	*	*	*	*	*	*	*
(<8-µ), µg/l	150	3.16	•	•	2230	•	•	$SD_{1,5}$	•
(<0.45-µ), µg/l	131	3.91	•	•	1110	•	•	$SD_{1,5}$	•
(<0.05-µ), µg/l	75.0	2.92	•	•	663	•	•	$SD_{1,5}$	•

(Continued)

Table 3 (Continued)

Parameters	Number Of Samples Influent	Number Of Samples Effluent	Number Of Samples Background Water	Range Influent	Range Effluent	Range Background Water	Mean Influent	Mean Effluent	Mean Background Water
In Oil									
& Grease, μg/l	4	6	1	5.83-13.6	1.17-5.79	•	10.9	3.31	•
Carb. Phase, mg/kg	6	Δ	Δ	5200-8020	☆	☆	6780	☆	☆
Exch. Phase, mg/kg	6	Δ	Δ	0.05-0.16	☆	☆	0.12	☆	☆
Manganese									
Slurry, mg/l	6	6	—	15.6-37.3	0.23-1.08	☆	26.1	0.61	☆
Solids, mg/kg	6	Δ	—	87.2-268	☆	☆	142	☆	☆
(<8-μ), μg/l	4	6	1	78.0-95.0	47.0-92.0	•	87.0	63.0	•
(<0.45-μ), μg/l	4	6	1	63.0-89.0	38.0-71.0	•	81.0	52.0	•
(<0.05-μ), μg/l	4	6	1	58.0-83.0	35.0-78.0	•	[illegible].0	49.0	•
In Oil									
& Grease, μg/l	4	6	1	0.64-0.89	0.11-3.58	•	0.74	0.77	•
Carb. Phase, mg/kg	6	Δ	Δ	228-326	☆	☆	278	☆	☆
Exch. Phase, mg/kg	6	Δ	Δ	23.2-42.9	☆	☆	31.3	☆	☆
Mercury									
Slurry, μg/l	6	6	1	72-112	1.3-4.8	•	85	3.1	•
Solids, mg/kg	6	Δ	Δ	0.35-0.59	☆	☆	0.46	☆	☆
(<8-μ), μg/l	4	6	1	0.20-0.32	0.17-0.34	•	0.24	0.24	•
(<0.45-μ), μg/l	4	6	1	0.15-0.24	0.15-0.22	•	0.19	0.18	•
(<0.05-μ), μg/l	4	6	1	0.08-0.18	0.08-0.18	•	0.13	0.13	•

Parameters	Standard Deviation Influent	Standard Deviation Effluent	Standard Deviation Background Water	F - Value Influent vs. Background W	F - Value Influent vs. Effluent	F - Value Effluent vs. Background W	Loading Influent vs. Background W	Removal Influent vs. Effluent	Impact Effluent vs. Background W
In Oil									
& Grease, μg/l	3.93	1.72	•	•	5.23	•	•	SD_5	•
Carb. Phase, mg/kg	1110	☆	☆	☆	☆	☆	☆	☆	☆
Exch. Phase, mg/kg	0.039	☆	☆	☆	☆	☆	☆	☆	☆
Manganese									
Slurry, mg/l	9.09	0.295	☆	☆	919	☆	☆	$SD_{1,5}$	☆
Solids, mg/kg	65.5	☆	☆	☆	☆	☆	☆	☆	☆
(<8-μ), μg/l	7.87	17.0	•	•	4.65	•	•	$NSD_{1,5}$	•
(<0.45-μ), μg/l	12.3	10.9	•	•	1.29	•	•	$NSD_{1,5}$	•
(<0.05-μ), μg/l	12.0	15.5	•	•	1.65	•	•	$NSD_{1,5}$	•
In Oil									
& Grease, μg/l	0.116	1.38	•	•	146	•	•	$SD_{1,5}$	•
Carb. Phase, mg/kg	38.1	☆	☆	☆	☆	☆	☆	☆	☆
Exch. Phase, mg/kg	8.85	☆	☆	☆	☆	☆	☆	☆	☆
Mercury									
Slurry, μg/l	14.6	1.23	•	•	142	•	•	$SD_{1,5}$	•
Solids, mg/kg	0.098	☆	☆	☆	☆	☆	☆	☆	☆
(<8-μ), μg/l	0.053	0.078	•	•	3.00	•	•	$NSD_{1,5}$	•
(<0.45-μ), μg/l	0.039	0.032	•	•	1.00	•	•	$NSD_{1,5}$	•
(<0.05-μ), μg/l	0.041	0.032	•	•	2.00	•	•	$NSD_{1,5}$	•

(Continued)

Table 3 (Continued)

Parameters	Number Of Samples Influent	Number Of Samples Effluent	Number Of Samples Background Water	Range Influent	Range Effluent	Range Background Water	Mean Influent	Mean Effluent	Mean Background Water
Nickel									
Slurry, mg/l	6	6	1	7.8-15.3	0.17-0.87	•	11.5	0.53	•
Solids, mg/kg	6	Δ	Δ	47.0-76.3	*	*	61.9	*	*
(<8-μ), μg/l	4	6	1	13.9-16.3	11.3-16.3	•	15.2	14.0	•
(<0.45-μ), μg/l	4	6	1	13.3-15.8	10.2-16.3	•	14.4	13.0	•
(<0.05-μ), μg/l	4	6	1	12.0-14.8	9.72-15.3	•	14.1	12.3	•
In Oil & Grease, μg/l	4	6	1	3.31-6.21	2.52-21.2	•	4.58	6.69	•
Carb.Phase, mg/kg	6	Δ	Δ	19.6-37.4	*	*	30.3	*	*
Exch.Phase, mg/kg	6	Δ	Δ	0.99-19.5	*	*	10.5	*	*
Lead									
Slurry, mg/l	6	6	1	10.3-13.7	0.046-0.182	•	12.3	0.105	•
Solids, mg/kg	6	Δ	Δ	55.4-74.1	*	*	66.9	*	*
(<8-μ), μg/l	4	6	—	4.83-7.18	4.91-9.94	*	5.99	6.55	*
(<0.45-μ), μg/l	4	6	—	1.20-6.67	4.37-9.28	*	4.62	6.10	*
(<0.05-μ), μg/l	4	6	1	4.13-6.55	4.22-9.23	•	5.22	5.99	•
In Oil & Grease, μg/l	4	6	1	1.57-3.47	0.73-4.14	•	2.65	1.44	•
Carb.Phase, mg/kg	6	Δ	Δ	0.19-11.3	*	*	2.70	*	*
Exch.Phase, mg/kg	6	Δ	Δ	0.45-0.98	*	*	0.66	*	*
Selenium									
Slurry, mg/l	6	6	1	3.63-5.61	0.123-0.204	•	4.95	0.157	•

Parameters	Standard Deviation Influent	Standard Deviation Effluent	Standard Deviation Background Water	F - Value Influent vs. Background W	F - Value Influent vs. Effluent	F - Value Effluent vs. Background W	Loading Influent vs. Background W	Removal Influent vs. Effluent	Impact Effluent vs. Background W
Nickel									
Slurry, mg/l	2.89	0.276	•	•	110	•	•	$SD_{1,5}$	•
Solids, mg/kg	11.7	*	*	*	*	*	*	*	*
(<8-μ), μg/l	1.12	2.31	•	•	4.28	•	•	$NSD_{1,5}$	•
(<0.45-μ), μg/l	1.28	2.12	•	•	2.76	•	•	$NSD_{1,5}$	•
(<0.05-μ), μg/l	1.37	1.90	•	•	1.93	•	•	$NSD_{1,5}$	•
In Oil & Grease, μg/l	1.22	7.28	•	•	35.5	•	•	$SD_{1,5}$	•
Carb.Phase, mg/kg	7.99	*	*	*	*	*	*	*	*
Exch.Phase, mg/kg	7.59	*	*	*	*	*	*	*	*
Lead									
Slurry, mg/l	1.21	0.053	•	•	486	•	•	$SD_{1,5}$	•
Solids, mg/kg	7.63	*	*	*	*	*	*	*	*
(<8-μ), μg/l	1.19	1.94	*	*	2.66	*	*	$NSD_{1,5}$	*
(<0.45-μ), μg/l	2.47	1.90	*	*	1.70	*	*	$NSD_{1,5}$	*
(<0.05-μ), μg/l	1.16	1.90	•	•	2.71	•	•	$NSD_{1,5}$	•
In Oil & Grease, μg/l	0.886	1.33	•	•	2.27	•	•	$NSD_{1,5}$	•
Carb.Phase, mg/kg	4.47	*	*	*	*	*	*	*	*
Exch.Phase, mg/kg	0.180	*	*	*	*	*	*	*	*
Selenium									
Slurry, mg/l	0.721	0.035	•	•	520	•	•	$SD_{1,5}$	•

(Continued)

Table 3 (Continued)

Parameters	Number Of Samples Influent	Effluent	Background Water	Range Influent	Effluent	Background Water	Mean Influent	Effluent	Background Water
Solids, mg/kg	6	Δ	Δ	23.4-31.3	*	*	26.8	*	*
(<8-μ),μg/l	4	6	1	1.70-2.15	<0.1-2.03	•	1.90	0.67	•
(<0.45-μ),μg/l	3	6	1	1.55-1.72	<0.1-1.83	•	1.65	0.52	•
(<0.05-μ),μg/l	4	5	1	0.37-1.54	<0.1-1.12	•	1.00	0.31	•
Titanium									
Slurry, mg/l	6	6	1	7.53-9.21	0.16-0.37	•	8.30	0.26	•
Solids, mg/kg	6	Δ	Δ	38.4-60.6	*	*	45.6	*	*
(<8-μ),μg/l	4	6	—	1.71-2.19	1.0-1.91	*	1.97	1.53	*
(<0.45-μ),μg/l	4	6	—	1.64-1.98	0.83-1.89	*	1.83	1.45	*
(<0.05-μ),μg/l	4	6	—	1.30-1.82	1.11-1.56	*	1.51	1.43	*
In Oil & Grease, μg/l	4	6	1	0.67-2.78	<0.1-0.63	•	1.45	0.23	•
Vanadium									
Slurry, mg/l	6	6	1	4.39-6.21	0.12-0.32	•	5.44	0.21	•
Solids, mg/kg	6	Δ	Δ	25.9-31.6	*	*	29.4	*	*
(<8-μ), μg/l	4	6	1	2.93-4.28	1.87-3.84	•	3.45	2.85	•
(<0.45-μ),μg/l	4	6	1	2.36-3.87	1.17-3.21	•	3.10	2.29	•
(<0.05-μ),μg/l	4	6	—	1.86-3.54	1.13-2.81	*	2.60	1.89	*
In Oil & Grease, μg/l	4	6	—	<0.05-0.72	<0.05-5.06	*	0.40	1.01	*
Carb.Phase,mg/kg	6	Δ	Δ	0.4-4.2	*	*	1.75	*	*
Exch.Phase,mg/kg	6	Δ	Δ	<0.1	*	*	TRACE	*	*

Parameters	Standard Deviation Influent	Effluent	Background Water	F - Value Influent vs. Background W	F - Value Influent vs. Effluent	F - Value Effluent vs. Background W	Loading Influent vs. Background W	Removal Influent vs. Effluent	Impact Effluent vs. Background W
Solids, mg/kg	2.57	*	*	*	*	*	*	*	*
(<8-μ),μg/l	0.199	1.04	•	•	2.82	•	•	$SD_{1,5}$	•
(<0.45-μ),μg/l	0.087	0.829	•	•	86.3	•	•	SD_5	•
(<0.05-μ),μg/l	0.526	0.491	•	•	1.17	•	•	$NSD_{1,5}$	•
Titanium									
Slurry, mg/l	0.626	0.076	•	•	65.0	•	•	$SD_{1,5}$	•
Solids, mg/kg	8.28	*	*	*	*	*	*	*	*
(<8-μ),μg/l	0.214	0.329	*	*	2.16	*	*	$NSD_{1,5}$	*
(<0.45-μ),μg/l	0.145	0.374	*	*	7.00	*	*	$NSD_{1,5}$	*
(<0.05-μ),μg/l	0.221	0.63	*	*	1.92	*	*	$NSD_{1,5}$	*
In Oil & Grease, μg/l	0.961	0.288	•	•	11.1	•	•	SD_5	•
Vanadium									
Slurry, mg/l	0.679	0.085	•	•	65.8	•	•	$SD_{1,5}$	•
Solids, mg/kg	2.06	*	*	*	*	*	*	*	*
(<8-μ), μg/l	0.583	0.979	•	•	2.82	•	•	$NSD_{1,5}$	•
(<0.45-μ),μg/l	0.621	0.829	•	•	1.76	•	•	$NSD_{1,5}$	•
(<0.05-μ),μg/l	0.704	0.653	*	*	1.14	*	*	$NSD_{1,5}$	*
In Oil & Grease, μg/l	0.312	1.99	*	*	40.8	*	*	$SD_{1,5}$	*
Carb.Phase,mg/kg	1.45	*	*	*	*	*	*	*	*
Exch.Phase,mg/kg	∿0	*	*	*	*	*	*	*	*

(Continued)

Table 3 (Continued)

Parameters	Number Of Samples Influent	Number Of Samples Effluent	Number Of Samples Background Water	Range Influent	Range Effluent	Range Background Water	Mean Influent	Mean Effluent	Mean Background Water
Zinc									
Slurry, mg/l	6	6	1	17.1-37.1	0.33-0.94	•	24.2	0.48	•
Solids, mg/kg	6	Δ	Δ	98.9-180	☆	☆	127	☆	☆
(<8-μ), μg/l	4	6	1	158-275	0.59-3.11	•	209	1.84	•
(<0.45-μ),μg/l	4	6	—	107-178	0.61-2.78	☆	143	1.65	☆
(<0.05-μ),μg/l	4	6	1	68-117	0.23-2.53	•	101	1.54	•
In Oil & Grease, μg/l	4	6	1	2.12-2.83	0.96-7.87	•	2.52	2.75	•
Carb. Phase, mg/kg	6	Δ	Δ	112-247	☆	☆	165	☆	☆
Exch. Phase, mg/kg	6	Δ	Δ	3.2-7.3	☆	☆	4.8	☆	☆
Chlorinated Hydrocarbons									
OP' DDD Slurry, mg/l	3	3	1	1.44-15.2	0.032-0.140	•	9.58	0.097	•
PP' DDD Slurry, mg/l	3	3	1	4.70-78.3	0.080-0.200	•	35.7	0.150	•
OP' DDE Slurry, mg/l	3	3	1	1.80-33.4	0.032-0.084	•	16.2	0.052	•
PP' DDE Slurry, mg/l	3	3	1	6.42-59.2	0.060-0.380	•	40.9	0.246	•

Parameters	Standard Deviation Influent	Standard Deviation Effluent	Standard Deviation Background Water	F - Value Influent vs. Background W	F - Value Influent vs. Effluent	F - Value Effluent vs. Background W	Loading Influent vs. Background W	Removal Influent vs. Effluent	Impact Effluent vs. Background W
Zinc									
Slurry, mg/l	9.55	0.231	•	•	1820	•	•	$SD_{1,5}$	•
Solids, mg/kg	31.7	☆	☆	☆	☆	☆	☆	☆	☆
(<8-μ), μg/l	52.1	1.05	•	•	2470	•	•	$SD_{1,5}$	•
(<0.45-μ),μg/l	39.0	1.10	☆	☆	1250	☆	☆	$SD_{1,5}$	☆
(<0.05-μ),μg/l	22.2	0.902	•	•	608	•	•	$SD_{1,5}$	•
In Oil & Grease, μg/l	0.308	2.54	•	•	68.0	•	•	$SD_{1,5}$	•
Carb. Phase, mg/kg	52.2	☆	☆	☆	☆	☆	☆	☆	☆
Exch. Phase, mg/kg	1.74	☆	☆	☆	☆	☆	☆	☆	☆
Chlorinated Hydrocarbons									
OP' DDD Slurry, mg/l	7.22	0.057	•	•	17400	•	•	$SD_{1,5}$	•
PP' DDD Slurry, mg/l	38.2	0.062	•	•	374000	•	•	$SD_{1,5}$	•
OP' DDE Slurry, mg/l	16.0	0.028	•	•	320000	•	•	$SD_{1,5}$	•
PP' DDE Slurry, mg/l	23.9	0.166	•	•	33100	•	•	$SD_{1,5}$	•

(Continued)

Table 3 (Continued)

Parameters	Number Of Samples: Influent	Number Of Samples: Effluent	Number Of Samples: Background Water	Range: Influent	Range: Effluent	Range: Background Water	Mean: Influent	Mean: Effluent	Mean: Background Water
OP' DDT Slurry, mg/l	3	3	1	1.36-11.0	0.010-0.080	•	6.48	0.050	•
PP' DDT Slurry, mg/l	3	3	1	2.10-12.5	0.002-0.080	•	7.84	0.047	•
Total DDT Slurry, mg/l	3	3	1	17.7-209	0.216-0.940	•	117	0.605	•
Aroclor 1242 Slurry, mg/l	3	3	1	11.6-98.7	0.150-1.20	•	57.2	0.650	•

Parameters	Standard Deviation: Influent	Standard Deviation: Effluent	Standard Deviation: Background Water	F - Value Influent vs. Background W	F - Value Influent vs. Effluent	F - Value Effluent vs. Background W	Loading Influent vs. Background W	Removal Influent vs. Effluent	Impact Effluent vs. Background W
OP' DDT Slurry, mg/l	4.85	0.036	•	•	23500	•	•	$SD_{1,5}$	•
PP' DDT Slurry, mg/l	5.29	0.041	•	•	14000	•	•	$SD_{1,5}$	•
Total DDT Slurry, mg/l	95.8	0.365	•	•	70600	•	•	$SD_{1,5}$	•
Aroclor 1242 Slurry, mg/l	43.7	0.527	•	•	6820	•	•	$SD_{1,5}$	•

(Continued)

Table 3 (Concluded)

Parameters	Number Of Samples			Range			Mean		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water	Influent	Effluent	Background Water
Aroclor 1254 Slurry, mg/l	3	3	1	4.20-24.4	0.010-0.080	•	16.9	0.037	•
Aroclor 1260 Slurry, mg/l	3	3	1	1.10-9.80	0.006-0.020	•	5.90	0.012	•
Total PCB Slurry, mg/l	3	3	1	16.9-133	0.166-1.28	•	80.1	0.715	•

Parameters	Standard Deviation			F - Value Influent vs. Background W	F - Value Influent vs. Effluent	F - Value Effluent vs. Background W	Loading Influent vs. Background W	Removal Influent vs. Effluent	Impact Effluent vs. Background W
	Influent	Effluent	Background Water						
Aroclor 1254 Slurry, mg/l	11.0	0.038	•	•	122000	•	•	$SD_{1,5}$	•
Aroclor 1260 Slurry, mg/l	4.42	0.007	•	•	391000	•	•	$SD_{1,5}$	•
Total PCB Slurry, mg/l	58.7	0.557	•	•	11100	•	•	$SD_{1,5}$	•

TABLE 4

Average Values For Field Data Of Influent, Effluent, and Background Water From Pinto Island (Mobile Bay, Alabama) and Grassy Island (Detroit, Michigan) Dredged Material Disposal Areas

	Number Of Samples					
	Pinto Island			Grassy Island		
Parameters	Influent	Effluent	Background Water	Influent	Effluent	Background Water
Slurry PH	—	—	—	9	9	3
Salinity, $^0/_{00}$	6	7	3	9	9	3
Conductivity, mMhos	6	6	3	9	9	3
Dissolved O_2, mg/l	6	9	3	9	9	3
Water Temp., ^0C	5	7	3	9	9	3

	Average Values					
	Pinto Island			Grassy Island		
Parameters	Influent	Effluent	Background Water	Influent	Effluent	Background Water
Slurry PH	—	—	—	7.1	7.2	7.0
Salinity, $^0/_{00}$	14.0	13.4	3.5	0.3	0.4	0.2
Conductivity, mMhos	24.3	25.4	6.3	0.36	0.71	0.29
Dissolved O_2, mg/l	0.7	2.4	7.6	7.4	7.3	7.0
Water Temp., ^0C	27.9	28.4	27.7	24.3	24.0	29.0

— Not Measured in Field.

TABLE 5

Average Values for Physical and Chemical Parameters of Influent, Effluent and Background Water Samples from the Pinto Island (Mobile Bay, Alabama) and Grassy Island (Detroit, Michigan) Dredged Material Disposal Areas

Parameters	Number Of Samples					
	Pinto Island			Grassy Island		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water
PH (<0.45-μ)	6	11	2	6	6	1
Salinity (<0.45-μ)	6	11	2	6	6	1
Conductivity, mMhos (<0.45-μ)	6	11	2	6	6	1
Dry Weight, %	6	11	2	6	6	1
Total Alkalinity, mg/l (<0.45-μ)	6	11	2	6	6	1
Chloride, mg/l (<0.45-μ)	6	11	2	6	5	1
Cation Exchange Capacity, meq/l	6	12	—	6	—	—

Parameters	Average Values					
	Pinto Island			Grassy Island		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water
PH (<0.45-μ)	7.4	7.8	7.6	8.3	8.3	7.3
Salinity (<0.45-μ)	25.5	20.5	3.0	TRACE	TRACE	TRACE
Conductivity, mMhos (<0.45-μ)	24.8	22.0	4.9	0.11	0.07	0.04
Dry Weight, %	7.06	3.83	0.46	18.6	(0.06)•	(0.01)•
Total Alkalinity, mg/l (<0.45-μ)	151	213	50	505	244	130
Chloride, mg/l (<0.45-μ)	13.5	11.6	1.90	50.6	47.9	26.8
Cation Exchange Capacity, meq/l	28.4	11.8	—	69.2	—	—

(Continued)

(—) Not Determined (Indicates Insufficient Sample or Sample Destroyed in Transit).

(•) Due to the Insufficient Amount of Solids, Values in ( ) are for Reference Only.

(*) Samples were Shaken and then Allowed to Settle. The Supernatant was withdrawn with a Hamilton Syringe (406 - μ opening) and injected into the TOC Analyzer.

Table 5 (Continued)

	Number Of Samples					
	Pinto Island			Grassy Island		
Parameters	Influent	Effluent	Background Water	Influent	Effluent	Background Water
Total Acid Soluble Sulfide, mg/l	5	11	2	6	6	1
Total Carbon Slurry						
Total *, mg/l	5	10	2	6	6	1
(<8-μ), mg/l	5	11	2	6	6	1
(<0.45-μ), mg/l	5	11	2	6	6	1
(<0.05-μ), mg/l	5	11	2	6	5	1
Organic Carbon						
Slurry Total *, mg/l	6	10	2	6	6	1
(<8-μ), mg/l	6	11	2	6	6	1
(<0.45-μ), mg/l	6	11	2	6	6	1
(<0.05-μ), mg/l	6	11	2	6	5	1
Oil & Grease						
Slurry Total , mg/l	6	11	2	6	4	1
Supernatant After 2 hr. settling, mg/l	3	3	1	—	3	1
Supernatant After 12 hrs.settling, mg/l	3	3	1	3	3	1
Supernatant After 24 hrs.settling, mg/l	3	3	1	3	3	1
Supernatant After 48 hrs.settling, mg/l	3	3	1	3	3	—

	Average Values					
	Pinto Island			Grassy Island		
Parameters	Influent	Effluent	Background Water	Influent	Effluent	Background Water
Total Acid Soluble Sulfide, mg/l	19.6	3.3	TRACE	38.4	0.2	TRACE
Total Carbon Slurry						
Total *, mg/l	59.3	93.8	18.2	214	97.0	38
(<8-μ), mg/l	39.8	57.0	13.9	166	68.0	29.5
(<0.45-μ), mg/l	38.4	55.2	11.3	154	64.0	30
(<0.05-μ), mg/l	38.4	52.5	12.3	130	59.0	28
Organic Carbon						
Slurry Total *, mg/l	19.4	40.4	7.2	63.0	24.0	12
(<8-μ), mg/l	10.3	8.5	4.5	27.0	20.0	5.2
(<0.45-μ), mg/l	10.3	6.4	3.2	24.0	11.0	3.5
(<0.05-μ), mg/l	9.8	6.8	3.1	19.0	14.0	3.0
Oil & Grease						
Slurry Total , mg/l	456	45	3.5	5260	25	32
Supernatant After 2 hr. settling, mg/l	57	4	3	—	3	8
Supernatant After 12 hrs.settling, mg/l	62	20	TRACE	818	8	TRACE
Supernatant After 24 hrs.settling, mg/l	155	27	TRACE	1570	10	12
Supernatant After 48 hrs.settling, mg/l	64	38	TRACE	339	12	—

(Continued)

Table 5 (Continued)

Parameters	Number Of Samples: Pinto Island Influent	Pinto Island Effluent	Pinto Island Background Water	Grassy Island Influent	Grassy Island Effluent	Grassy Island Background Water
NH_3 -N						
Slurry Total, mg/l	3	2	1	2	3	1
(<8-μ), mg/l	3	2	1	3	3	1
(<0.45-μ), mg/l	3	2	1	3	3	1
(<0.05-μ), mg/l	1	2	1	2	1	1
Organic-N						
Slurry Total, mg/l	3	2	1	3	3	1
(<8-μ), mg/l	3	2	1	3	3	1
(<0.45-μ), mg/l	3	2	1	3	3	1
(<0.05-μ), mg/l	2	1	1	2	1	1
NO_3 -N						
(<0.45-μ), mg/l	3	2	1	3	3	1
NO_2 -N						
(<0.45-μ), mg/l	3	2	1	3	3	1
Total - P						
Slurry Total, mg/l	3	2	1	3	3	1
(<8-μ), mg/l	3	2	1	3	3	1
(<0.45-μ), mg/l	3	2	1	3	3	1
(<0.05-μ), mg/l	3	2	1	3	3	1

Parameters	Average Values: Pinto Island Influent	Pinto Island Effluent	Pinto Island Background Water	Grassy Island Influent	Grassy Island Effluent	Grassy Island Background Water
NH_3 -N						
Slurry Total, mg/l	10.2	13.2	TRACE	83.8	14.2	TRACE
(<8-μ), mg/l	5.10	2.13	TRACE	40.7	13.2	TRACE
(<0.45-μ), mg/l	4.83	2.00	TRACE	38.5	13.0	TRACE
(<0.05-μ), mg/l	9.40	1.21	TRACE	40.9	12.8	TRACE
Organic-N						
Slurry Total, mg/l	31.1	12.4	0.91	60.5	2.57	1.10
(<8-μ), mg/l	7.47	7.46	0.64	6.77	1.98	0.96
(<0.45-μ), mg/l	8.78	7.08	0.34	5.82	1.47	0.80
(<0.05-μ), mg/l	9.05	5.50	0.24	5.62	1.76	0.80
NO_3 -N						
(<0.45-μ), mg/l	0.28	0.23	0.09	0.20	0.11	0.10
NO_2 -N						
(<0.45-μ), mg/l	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
Total - P						
Slurry Total, mg/l	74.3	42.5	0.19	129	0.15	0.06
(<8-μ), mg/l	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
(<0.45-μ), mg/l	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
(<0.05-μ), mg/l	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE

(Continued)

Table 5 (Continued)

Parameters	Number Of Samples					
	Pinto Island			Grassy Island		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water
Sodium						
Slurry Total, mg/l	—	—	1	2	—	—
(<8-μ), mg/l	5	8	2	1	4	1
(<0.45-μ),mg/l	3	2	2	3	3	1
(<0.05-μ),mg/l	5	5	1	2	6	1
Potassium						
Slurry Total, mg/l	4	12	—	4	6	—
Solids, mg/kg	4	11	—	4	—	—
(<8-μ), mg/l	4	12	—	4	6	—
(<0.45-μ),mg/l	4	12	—	4	6	—
(<0.05-μ),mg/l	4	12	—	4	6	—
Calcium						
Slurry Total, mg/l	4	12	2	4	6	1
Solids, mg/kg	4	11	2	4	—	—
(<8-μ), mg/l	4	12	2	4	6	1
(<0.45-μ),mg/l	4	12	2	4	6	1
(<0.05-μ),mg/l	4	12	2	4	6	1
Magnesium						
Slurry Total, mg/l	—	—	—	4	6	1
Solids, mg/kg	—	—	—	4	—	—
(<8-μ), mg/l	4	12	2	4	6	1
(<0.45-μ),mg/l	4	12	2	4	6	1
(<0.05-μ),mg/l	4	12	2	4	6	1

Parameters	Average Values					
	Pinto Island			Grassy Island		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water
Sodium						
Slurry Total, mg/l	—	—	—	235	—	—
(<8-μ), mg/l	8460	6730	1280	24.5	28.8	29.5
(<0.45-μ),mg/l	7600	6150	1280	24.5	28.7	13.5
(<0.05-μ),mg/l	7570	5850	1320	20.8	22.8	13.0
Potassium						
Slurry Total, mg/l	1630	745	—	886	345	—
Solids, mg/kg	26800	19500	—	4670	—	—
(<8-μ), mg/l	184	136	—	148	123	—
(<0.45-μ),mg/l	175	129	—	138	118	—
(<0.05-μ),mg/l	164	126	—	129	113	—
Calcium						
Slurry Total, mg/l	668	513	68	62.4	35.0	4.51
Solids, mg/kg	8090	13300	14800	342	—	—
(<8-μ), mg/l	470	327	65.8	49.8	30.8	4.42
(<0.45-μ),mg/l	462	311	64.2	48.8	29.0	3.38
(<0.05-μ),mg/l	440	287	62.1	46.4	27.2	3.42
Magnesium						
Slurry Total, mg/l	—	—	—	174	156	9.2
Solids, mg/kg	—	—	—	948	—	—
(<8-μ), mg/l	1330	1060	222	87.8	38.2	8.8
(<0.45-μ),mg/l	1220	959	216	79.6	36.9	8.0
(<0.05-μ),mg/l	1170	923	192	72.0	32.9	8.9

(Continued)

Table 5 (Continued)

Parameters	Number Of Samples					
	Pinto Island			Grassy Island		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water
Arsenic						
Slurry Total, μg/l	—	—	—	—	—	—
Oil & Grease Fraction, μg/l	4	12	—	4	6	—
Percent Of Total (Oil & Grease), %	—	—	—	—	—	—
In Dry Oil & Grease, ppm	4	11	—	4	4	—
Carbonate Phase, mg/kg	6	12	—	6	—	—
Exchangeable Phase, mg/kg	6	12	—	6	—	—
Cadmium						
Slurry Total, μg/l	6	12	2	6	5	1
Solids, mg/kg	6	11	2	6	—	—
(<8-μ), μg/l	4	12	2	4	6	1
(<0.45-μ), μg/l	4	12	2	4	6	1
(<0.05-μ), μg/l	4	12	2	4	6	1
Oil & Grease Fraction, μg/l	4	12	2	4	6	1
Percent Of Total (Oil & Grease), %	4	12	2	4	6	1
In Dry Oil & Grease, ppm	4	12	2	4	6	1
Carbonate Phase, mg/kg	6	12	—	6	—	—
Exchangeable Phase, mg/kg	6	12	—	6	—	—

Parameters	Average Values					
	Pinto Island			Grassy Island		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water
Arsenic						
Slurry Total, μg/l	—	—	—	—	—	—
Oil & Grease Fraction, μg/l	0.56	0.27	—	0.87	0.59	—
Percent Of Total (Oil & Grease), %	—	—	—	—	—	—
In Dry Oil & Grease, ppm	1.23	6.00	—	0.165	39.3	—
Carbonate Phase, mg/kg	0.376	0.315	—	0.52	—	—
Exchangeable Phase, mg/kg	0.192	0.268	—	0.14	—	—
Cadmium						
Slurry Total, μg/l	89.3	73.1	2.38	435	1.86	1.27
Solids, mg/kg	1.41	1.86	0.525	2.47	—	—
(<8-μ), μg/l	3.39	2.92	0.990	5.13	0.89	0.12
(<0.45-μ), μg/l	2.94	2.23	0.925	4.33	0.94	0.13
(<0.05-μ), μg/l	2.69	2.00	0.670	3.67	0.71	0.09
Oil & Grease Fraction, μg/l	1.54	0.05	TRACE	0.13	0.21	TRACE
Percent Of Total (Oil & Grease), %	1.73	0.062	TRACE	0.029	11.1	TRACE
In Dry Oil & Grease, ppm	3.38	1.00	TRACE	0.024	13.8	TRACE
Carbonate Phase, mg/kg	0.088	0.143	—	0.150	—	—
Exchangeable Phase, mg/kg	0.010	0.052	—	0.025	—	—

(Continued)

Table 5 (Continued)

Parameters	Number Of Samples: Pinto Island Influent	Pinto Island Effluent	Pinto Island Background Water	Grassy Island Influent	Grassy Island Effluent	Grassy Island Background Water
Chromium						
Slurry Total, mg/l	—	—	—	—	—	—
Oil & Grease Fraction, µg/l	4	12	—	4	6	—
Percent Of Total (Oil & Grease), %	—	—	—	—	—	—
In Dry Oil & Grease, ppm	4	11	—	4	4	—
Carbonate Phase, mg/kg	6	12	—	6	—	—
Exchangeable Phase, mg/kg	6	12	—	6	—	—
Copper						
Slurry Total, mg/l	6	12	2	6	6	1
Solids, mg/kg	6	11	2	6	—	—
(<8-µ), µg/l	4	12	2	4	6	1
(<0.45-µ), µg/l	4	12	2	4	6	1
(<0.05-µ), µg/l	4	12	2	4	6	1
Oil & Grease Fraction, µg/l	4	12	2	4	6	1
Percent Of Total (Oil & Grease), %	4	12	2	4	6	1
In Dry Oil & Grease, ppm	4	11	2	4	4	1
Carbonate Phase, mg/kg	6	12	—	6	—	—
Exchangeable Phase, mg/kg	6	12	—	6	—	—

Parameters	Average Values: Pinto Island • Influent	Pinto Island Effluent	Pinto Island Background Water	Grassy Island Influent	Grassy Island Effluent	Grassy Island Background Water
Chromium						
Slurry Total, mg/l	—	—	—	—	—	—
Oil & Grease Fraction, µg/l	0.73	0.44	—	0.66	0.69	—
Percent Of Total (Oil & Grease), %	—	—	—	—	—	—
In Dry Oil & Grease, ppm	1.60	9.78	—	0.125	46.0	—
Carbonate Phase, mg/kg	0.90	0.78	—	12.7	—	—
Exchangeable Phase, mg/kg	0.21	0.24	—	0.13	—	—
Copper						
Slurry Total, mg/l	2.73	1.31	0.43	93.8	1.62	0.27
Solids, mg/kg	49.0	33.9	91.5	123	—	—
(<8-µ), µg/l	4.59	5.44	1.99	12.2	5.61	2.6
(<0.45-µ), µg/l	3.96	4.99	2.04	10.5	5.07	2.1
(<0.05-µ), µg/l	3.11	4.51	1.86	9.60	4.43	2.3
Oil & Grease Fraction, µg/l	3.51	2.52	1.64	4.72	3.46	0.31
Percent Of Total (Oil & Grease), %	0.129	0.192	0.381	0.021	0.214	0.337
In Dry Oil & Grease, ppm	7.90	83.4	498	0.897	231	28.4
Carbonate Phase, mg/kg	0.57	2.97	—	0.74	—	—
Exchangeable Phase, mg/kg	0.17	0.37	—	0.19	—	—

(Continued)

Table 5 (Continued)

Parameters	Number Of Samples					
	Pinto Island			Grassy Island		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water
Iron						
Slurry Total, mg/l	6	12	—	6	6	1
Solids, mg/kg	6	11	—	6	—	—
(<8-μ), μg/l	4	12	2	4	6	1
(<0.45-μ), μg/l	4	12	2	4	6	1
(<0.05-μ), μg/l	4	12	2	4	6	1
Oil & Grease Fraction, μg/l	4	12	2	4	6	1
Percent Of Total (Oil & Grease), %	4	12	—	4	6	1
In Dry Oil & Grease, ppm	4	11	2	4	4	1
Carbonate Phase, mg/kg	6	12	—	6	—	—
Exchangeable Phase, mg/kg	6	12	—	6	—	—

Parameters	Average Values					
	Pinto Island			Grassy Island		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water
Iron						
Slurry Total, mg/l	2290	1230	—	5620	46.8	0.03
Solids, mg/kg	32300	31900	—	30700	—	—
(<8-μ), μg/l	218	95.5	4.27	691	6.44	13.5
(<0.45-μ), μg/l	118	19.6	2.8	136	5.20	5.5
(<0.05-μ), μg/l	102	13.8	1.2	87.8	4.00	4.3
Oil & Grease Fraction, μg/l	707	3.77	1.67	10.9	3.31	2.34
Percent Of Total (Oil & Grease), %	0.031	0.0003	—	0.0002	0.007	7.8
In Dry Oil & Grease, ppm	1550	83.8	481	2.07	221	73.1
Carbonate Phase, mg/kg	3580	1910	—	6780	—	—
Exchangeable Phase, mg/kg	0.353	0.146	—	0.12	—	—

(Continued)

Table 5 (Continued)

Parameters	Number Of Samples					
	Pinto Island			Grassy Island		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water
Manganese						
Slurry Total, mg/l	6	12	1	6	6	—
Solids, mg/kg	6	11	1	6	—	—
(<8-μ), μg/l	4	12	—	4	6	1
(<0.45-μ),μg/l	4	12	—	4	6	1
(<0.05-μ),μg/l	4	12	—	4	6	1
Oil & Grease Fraction, μg/l	4	12	2	4	6	1
Percent Of Total (Oil & Grease), %	4	12	1	4	6	—
In Dry Oil & Grease, ppm						
Carbonate Phase, mg/kg	6	12	—	6	—	—
Exchangeable Phase, mg/kg	6	12	—	6	—	—
Mercury						
Slurry Total, μg/l	6	12	2	6	6	1
Solids, mg/kg	6	11	—	6	—	—

Parameters	Average Values					
	Pinto Island			Grassy Island		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water
Manganese						
Slurry Total, mg/l	45.4	20.8	2.3	26.1	0.61	—
Solids, mg/kg	716	523	547	142	—	—
(<8-μ), μg/l	5.07	3.87	—	87.0	63.0	2
(<0.45-μ),μg/l	4.89	3.72	—	81.0	52.0	2
(<0.05-μ),μg/l	4.73	3.58	—	76.0	49.0	2
Oil & Grease Fraction, μg/l	1.73	1.37	TRACE	0.74	0.77	TRACE
Percent Of Total (Oil & Grease), %	0.004	0.007	TRACE	0.003	0.128	—
In Dry Oil & Grease, ppm	3.77	30.7	TRACE	0.141	51.3	TRACE
Carbonate Phase, mg/kg	246	258	—	278	—	—
Exchangeable Phase, mg/kg	154	43.1	—	31.3	—	—
Mercury						
Slurry Total, μg/l	34.5	21.9	TRACE	85	3.1	1.0
Solids, mg/kg	0.55	0.59	—	0.46	—	—

(Continued)

Table 5 (Continued)

Parameters	Number Of Samples					
	Pinto Island			Grassy Island		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water
(<8-μ), μg/l	4	12	2	4	6	1
(<0.45-μ), μg/l	4	12	2	4	6	1
(<0.05-μ), μg/l	4	12	2	4	6	1
Nickel						
Slurry Total, mg/l	6	9	2	6	6	1
Solids, mg/kg	6	8	—	6	—	—
(<8-μ), μg/l	4	12	2	4	6	1
(<0.45-μ), μg/l	4	12	2	3	6	1
(<0.05-μ), μg/l	4	12	2	4	6	1
Oil & Grease Fraction, μg/l	4	12	2	4	6	1
Percent Of Total (Oil & Grease), %	4	9	2	4	6	1
In Dry Oil & Grease, ppm	4	11	2	4	4	1
Carbonate Phase, mg/kg	6	12	—	6	—	—
Exchangeable Phase, mg/kg	6	12	—	6	—	—
Lead						
Slurry Total, mg/l	6	12	2	6	6	1
Solids, mg/kg	6	11	2	6	—	—

Parameters	Average Values					
	Pinto Island			Grassy Island		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water
(<8-μ), μg/l	0.28	0.19	0.035	0.24	0.24	0.07
(<0.45-μ), μg/l	0.23	0.16	0.035	0.19	0.18	0.07
(<0.05-μ), μg/l	0.22	0.17	0.030	0.13	0.13	0.05
Nickel						
Slurry Total, mg/l	1.83	0.60	0.004	11.5	0.53	0.004
Solids, mg/kg	24.5	16.9	—	61.9	—	—
(<8-μ), μg/l	8.44	7.79	3.47	15.2	14.0	2.83
(<0.45-μ), μg/l	7.66	7.08	3.3	14.4	13.0	2.7
(<0.05-μ), μg/l	7.54	6.55	3.02	14.1	12.3	2.2
Oil & Grease Fraction, μg/l	4.54	3.74	TRACE	4.58	6.69	1.40
Percent Of Total (Oil & Grease), %	0.248	0.624	TRACE	0.04	1.40	35.0
In Dry Oil & Grease, ppm	9.96	83.1	TRACE	1.01	414	43.8
Carbonate Phase, mg/kg	1.63	1.79	—	30.3	—	—
Exchangeable Phase, mg/kg	0.128	0.252	—	10.5	—	—
Lead						
Slurry Total, mg/l	5.22	3.40	0.44	12.3	0.105	0.047
Solids, mg/kg	77.1	76.7	98.5	66.9	—	—

(Continued)

Table 5 (Continued)

Parameters	Number Of Samples					
	Pinto Island			Grassy Island		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water
(<8-μ), μg/l	4	12	2	4	6	—
(<0.45-μ), μg/l	4	12	2	4	6	—
(<0.05-μ), μg/l	4	12	2	4	6	1
Oil & Grease Fraction, μg/l	4	12	2	4	6	1
Percent Of Total (Oil & Grease), %	4	12	2	4	6	1
In Dry Oil & Grease, ppm	4	11	2	4	4	1
Carbonate Phase, mg/kg	6	12	—	6	—	—
Exchangeable Phase, mg/kg	6	12	—	6	—	—
Selenium						
Slurry Total, mg/l	6	12	—	6	6	1
Solids, mg/kg	6	11	—	6	—	—
(<8-μ), μg/l	3	12	2	4	6	1
(<0.45-μ), μg/l	3	12	2	3	6	1
(<0.05-μ), μg/l	1	12	2	4	5	1
Titanium						
Slurry Total, mg/l	6	12	2	6	6	1
Solids, mg/kg	6	11	—	6	—	—
(<8-μ), μg/l	4	12	2	4	6	—
(<0.45-μ), μg/l	4	12	2	4	6	—

Parameters	Average Values					
	Pinto Island			Grassy Island		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water
(<8-μ), μg/l	6.54	4.65	1.45	5.99	6.55	—
(<0.45-μ), μg/l	6.15	4.30	1.42	4.62	6.10	—
(<0.05-μ), μg/l	5.49	3.85	1.05	5.22	5.99	1.1
Oil & Grease Fraction, μg/l	3.87	0.97	TRACE	2.65	1.44	TRACE
Percent Of Total (Oil & Grease), %	0.074	0.028	TRACE	0.022	1.66	TRACE
In Dry Oil & Grease, ppm	8.49	21.5	TRACE	0.604	142	TRACE
Carbonate Phase, mg/kg	2.19	1.71	—	2.70	—	—
Exchangeable Phase, mg/kg	0.07	0.11	—	0.66	—	—
Selenium						
Slurry Total, mg/l	3.10	1.89	—	4.95	0.157	0.008
Solids, mg/kg	47.9	48.9	—	26.8	—	—
(<8-μ), μg/l	3.47	2.85	0.53	1.90	0.67	TRACE
(<0.45-μ), μg/l	3.31	2.62	0.56	1.65	0.52	TRACE
(<0.05-μ), μg/l	4.47	2.39	0.49	1.00	0.31	TRACE
Titanium						
Slurry Total, mg/l	5.24	2.74	TRACE	8.30	0.26	TRACE
Solids, mg/kg	78.6	74.2	—	45.6	—	—
(<8-μ), μg/l	4.33	3.17	TRACE	1.97	1.53	—
(<0.45-μ), μg/l	4.32	3.04	TRACE	1.83	1.45	—

(Continued)

Table 5 (Continued)

Parameters	Number Of Samples					
	Pinto Island			Grassy Island		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water
(<0.05-μ), μg/l	2	12	2	4	6	—
Oil & Grease Fraction, μg/l	4	12	—	4	6	1
Percent Of Total						
(Oil & Grease), %	4	12	—	4	6	1
In Dry Oil & Grease, ppm	4	12	—	4	5	1
Vanadium						
Slurry Total, mg/l	6	12	—	6	6	1
Solids, mg/kg	6	11	—	6	—	—
(<8-μ), μg/l	4	12	2	4	6	1
(<0.45-μ), μg/l	4	12	2	4	6	1
(<0.05-μ), μg/l	4	12	2	4	6	—
Oil & Grease Fraction, μg/l	4	12	—	4	6	—
Percent Of Total						
(Oil & Grease), %	4	12	—	4	6	—
In Dry Oil & Grease, ppm	4	11	—	4	4	—
Carbonate Phase, mg/kg	6	12	—	6	—	—
Exchangeable Phase, mg/kg	6	12	—	6	—	—
Zinc						
Slurry Total, μg/l	6	12	2	6	6	1
Solids, mg/kg	6	11	—	6	—	—
(<8-μ), μg/l	4	12	2	4	6	1

Parameters	Average Values					
	Pinto Island			Grassy Island		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water
(<0.05-μ), μg/l	4.49	2.88	TRACE	1.51	1.43	—
Oil & Grease Fraction, μg/l	0.66	0.12	—	1.45	0.23	TRACE
Percent Of Total						
(Oil & Grease), %	0.013	0.004	—	0.018	0.080	TRACE
In Dry Oil & Grease, ppm	1.45	2.62	—	0.283	9.94	TRACE
Vanadium						
Slurry Total, mg/l	3.68	2.02	—	5.44	0.21	0.003
Solids, mg/kg	56.7	50.2	—	29.4	—	—
(<8-μ), μg/l	7.57	4.12	TRACE	3.45	2.85	0.11
(<0.45-μ), μg/l	6.96	4.02	TRACE	3.10	2.29	0.07
(<0.05-μ), μg/l	6.58	3.79	TRACE	2.60	1.89	—
Oil & Grease Fraction, μg/l	1.78	0.93	—	0.40	1.01	—
Percent Of Total						
(Oil & Grease), %	0.048	0.046	—	0.007	0.480	—
In Dry Oil & Grease, ppm	3.90	20.7	—	0.076	67.3	—
Carbonate Phase, mg/kg	4.23	0.367	—	1.75	—	—
Exchangeable Phase, mg/kg	TRACE	TRACE	—	TRACE	—	—
Zinc						
Slurry Total, μg/l	16.4	10.7	1.12	24.2	0.48	0.23
Solids, mg/kg	237	272	—	127	—	—
(<8-μ), μg/l	1.55	1.19	0.425	209	1.84	2.19

(Continued)

Table 5 (Continued)

Parameters	Number Of Samples: Pinto Island: Influent	Pinto Island: Effluent	Pinto Island: Background Water	Grassy Island: Influent	Grassy Island: Effluent	Grassy Island: Background Water
(<0.45-μ), μg/l	4	12	2	4	6	—
(<0.05-μ), μg/l	4	12	2	4	6	1
Oil & Grease Fraction, μg/l	4	12	2	4	6	1
Percent Of Total (Oil & Grease), %	4	12	2	4	6	1
In Dry Oil & Grease, ppm	4	11	2	4	4	1
Carbonate Phase, mg/kg	6	12	—	6	—	—
Exchangeable Phase, mg/kg	6	12	—	6	—	—
Chlorinated Hydrocarbons OP' DDD						
Slurry Total, μg/l	3	3	1	3	3	1
Supernatant After 2 hr. settling, μg/l	3	—	1	3	—	1
Supernatant After 12 hrs. settling, μg/l	3	—	1	3	—	1
Supernatant After 48 hrs. settling, μg/l	3	—	1	3	—	1

Parameters	Average Values: Pinto Island: Influent	Pinto Island: Effluent	Pinto Island: Background Water	Grassy Island: Influent	Grassy Island: Effluent	Grassy Island: Background Water
(<0.45-μ), μg/l	0.28	1.11	1.15	143	1.65	—
(<0.05-μ), μg/l	0.28	1.04	0.94	101	1.54	2.00
Oil & Grease Fraction, μg/l	3.28	1.12	0.735	2.52	2.75	0.83
Percent Of Total (Oil & Grease), %	0.020	0.011	0.065	0.010	0.573	0.365
In Dry Oil & Grease, ppm	7.19	24.9	210	0.470	183	26.3
Carbonate Phase, mg/kg	44.2	55.2	—	165	—	—
Exchangeable Phase, mg/kg	0.29	5.55	—	4.8	—	—
Chlorinated Hydrocarbons OP' DDD						
Slurry Total, μg/l	272	111	1	9580	97.0	60
Supernatant After 2 hr. settling, μg/l	52	—	1	2180	—	13
Supernatant After 12 hrs. settling, μg/l	3	—	TRACE	137	—	TRACE
Supernatant After 48 hrs. settling, μg/l	TRACE	—	TRACE	9	—	TRACE

(Continued)

Table 5 (Continued)

Parameters	Number Of Samples					
	Pinto Island			Grassy Island		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water
PP' DDD						
Slurry Total, μg/l	3	3	1	3	3	1
Supernatant After 2 hr. settling, μg/l	3	—	1	3	—	1
Supernatant After 12 hrs.settling, μg/l	3	—	1	3	—	1
Supernatant After 48 hrs.settling, μg/l	3	—	1	3	—	1
OP' DDE						
Slurry Total, μg/l	3	3	1	3	3	1
Supernatant After 2 hr. settling, μg/l	3	—	1	3	—	1
Supernatant After 12 hrs.settling, μg/l	3	—	1	3	—	1
Supernatant After 48 hrs.settling, μg/l	3	—	1	3	—	1
PP' DDE						
Slurry Total, μg/l	3	3	1	3	3	1
Supernatant After 2 hr. settling, μg/l	3	—	1	3	—	1
Supernatant After 12 hrs.settling, μg/l	3	—	1	3	—	1
Supernatant After 48 hrs.settling, μg/l	3	—	1	3	—	1

Parameters	Average Values					
	Pinto Island			Grassy Island		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water
PP' DDD						
Slurry Total, μg/l	466	140	2	35700	150	80
Supernatant After 2 hr. settling, μg/l	103	—	4	8100	—	9
Supernatant After 12 hrs.settling, μg/l	6	—	TRACE	507	—	TRACE
Supernatant After 48 hrs.settling, μg/l	TRACE	—	TRACE	22.7	—	TRACE
OP' DDE						
Slurry Total, μg/l	162	40	2	16200	52	50
Supernatant After 2 hr. settling, μg/l	42	—	2	3680	—	10
Supernatant After 12 hrs.settling, μg/l	2	—	TRACE	228	—	TRACE
Supernatant After 48 hrs.settling, μg/l	TRACE	—	TRACE	13	—	TRACE
PP' DDE						
Slurry Total, μg/l	442	109	4	40900	246	80
Supernatant After 2 hr. settling, μg/l	198	—	13	17800	—	18
Supernatant After 12 hrs.settling, μg/l	24	—	TRACE	2230	—	TRACE
Supernatant After 48 hrs.settling, μg/l	2	—	TRACE	210	—	TRACE

(Continued)

Table 5 (Continued)

Parameters	Number Of Samples					
	Pinto Island			Grassy Island		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water
OP' DDT						
Slury Total, μg/l	3	3	1	3	3	1
Supernatant After 2 hr. settling, μg/l	3	—	1	3	—	1
Supernatant After 12 hrs.settling, μg/l	3	—	1	3	—	1
Supernatant After 48 hrs.settling, μg/l	3	—	1	3	—	1
PP' DDT						
Slurry Total, μg/l	3	3	1	3	3	1
Supernatant After 2 hr. settling, μg/l	3	—	1	3	—	1
Supernatant After 12 hrs.settling, μg/l	3	—	1	3	—	1
Supernatant After 48 hrs.settling, μg/l	3	—	1	3	—	1
TOTAL DDT						
Slurry Total, μg/l	3	3	1	3	3	1
Supernatant After 2 hr. settling, μg/l	3	—	1	3	—	1
Supernatant After 12 hrs.settling, μg/'	3	—	1	3	—	1
Supernatant After 48 hrs.settling, μg/l	3	—	1	3	—	1

Parameters	Average Values					
	Pinto Island			Grassy Island		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water
OP' DDT						
Slury Total, μg/l	186	TRACE	TRACE	6480	50	20
Supernatant After 2 hr. settling, μg/l	121	—	TRACE	4300	—	4
Supernatant After 12 hrs.settling, μg/l	28	—	TRACE	1070	—	180
Supernatant After 48 hrs.settling, μg/l	4	—	TRACE	46.7	—	TRACE
PP' DDT						
Slurry Total, μg/l	472	TRACE	TRACE	7840	47	40
Supernatant After 2 hr. settling, μg/l	309	—	TRACE	3370	—	18
Supernatant After 12 hrs.settling, μg/l	37	—	TRACE	433	—	TRACE
Supernatant After 48 hrs.settling, μg/l	2	—	TRACE	35	—	TRACE
TOTAL DDT						
Slurry Total, μg/l	2010	400	9	117000	605	330
Supernatant After 2 hr. settling, μg/l	874	—	20	39500	—	72
Supernatant After 12 hrs.settling, μg/l	87	—	TRACE	2950	—	TRACE
Supernatant After 48 hrs.settling, μg/l	7	—	TRACE	337	—	TRACE

(Continued)

Table 5 (Continued)

Parameters	Number Of Samples					
	Pinto Island			Grassy Island		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water
Aroclor 1242						
Slurry Total, µg/l	3	3	1	3	3	1
Supernatant After 2 hr. settling, µg/l	3	—	1	3	—	1
Supernatant After 12 hrs.settling, µg/l	3	—	1	3	—	1
Supernatant After 48 hrs.settling, µg/l	3	—	1	3	—	1
Aroclor 1254						
Slurry Total, µg/l	3	3	1	3	3	1
Supernatant After 2 hr. settling, µg/l	3	—	1	3	—	1
Supernatant After 12 hrs.settling, µg/l	3	—	1	3	—	1
Supernatant After 48 hrs.settling, µg/l	3	—	1	3	—	1
Aroclor 1260						
Slurry Total, µg/l	3	3	1	3	3	1
Supernatant After 2 hr. settling, µg/l	3	—	1	3	—	1

Parameters	Average Values					
	Pinto Island			Grassy Island		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water
Aroclor 1242						
Slurry Total, µg/l	806	33	TRACE	57200	650	200
Supernatant After 2 hr. settling, µg/l	217	—	TRACE	14100	—	100
Supernatant After 12 hrs.settling, µg/l	87	—	TRACE	3520	—	TRACE
Supernatant After 48 hrs.settling, µg/l	TRACE	—	TRACE	560	—	TRACE
Aroclor 1254						
Slurry Total, µg/l	443	13	TRACE	16900	37	10
Supernatant After 2 hr. settling, µg/l	73	—	TRACE	2600	—	1
Supernatant After 12 hrs.settling, µg/l	17	—	TRACE	433	—	TRACE
Supernatant After 48 hrs.settling, µg/l	TRACE	—	TRACE	51.7	—	TRACE
Aroclor 1260						
Slurry Total, µg/l	136	1	TRACE	5900	12	1
Supernatant After 2 hr. settling, µg/l	33	—	TRACE	960	—	0.1

(Continued)

Table 5 (Concluded)

Parameters	Number Of Samples					
	Pinto Island			Grassy Island		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water
Supernatant After 12 hrs. settling, μg/l	3	—	1	3	—	1
Supernatant After 48 hrs. settling, μg/l	3	—	1	3	—	1
TOTAL PCB						
Slurry Total, μg/l	3	3	1	3	3	1
Supernatant After 2 hr. settling, μg/l	3	—	1	3	—	1
Supernatant After 12 hrs. settling, μg/l	3	—	1	3	—	1
Supernatant After 48 hrs. settling, g/l	3	—	1	3	—	1

Parameters	Average Values					
	Pinto Island			Grassy Island		
	Influent	Effluent	Background Water	Influent	Effluent	Background Water
Supernatant After 12 hrs. settling, μg/l	2	—	TRACE	157	—	TRACE
Supernatant After 48 hrs. settling, μg/l	TRACE	—	TRACE	17.7	—	TRACE
TOTAL PCB						
Slurry Total, μg/l	1380	48	TRACE	80100	715	210
Supernatant After 2 hr. settling, μg/l	323	—	TRACE	17800	—	100
Supernatant After 12 hrs. settling, μg/l	105	—	TRACE	4080	—	TRACE
Supernatant After 48 hrs. settling, g/l	TRACE	—	TRACE	629	—	TRACE

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CHARACTERIZATION OF CONFINED DISPOSAL AREA INFLUENT AND EFFLUEN--ETC(U)
MAY 78 J C LU, B EICHENBERGER, M KNEZEVIC DACW39-76-C-0038
UNCLASSIFIED WES-TR-D-78-16 NL

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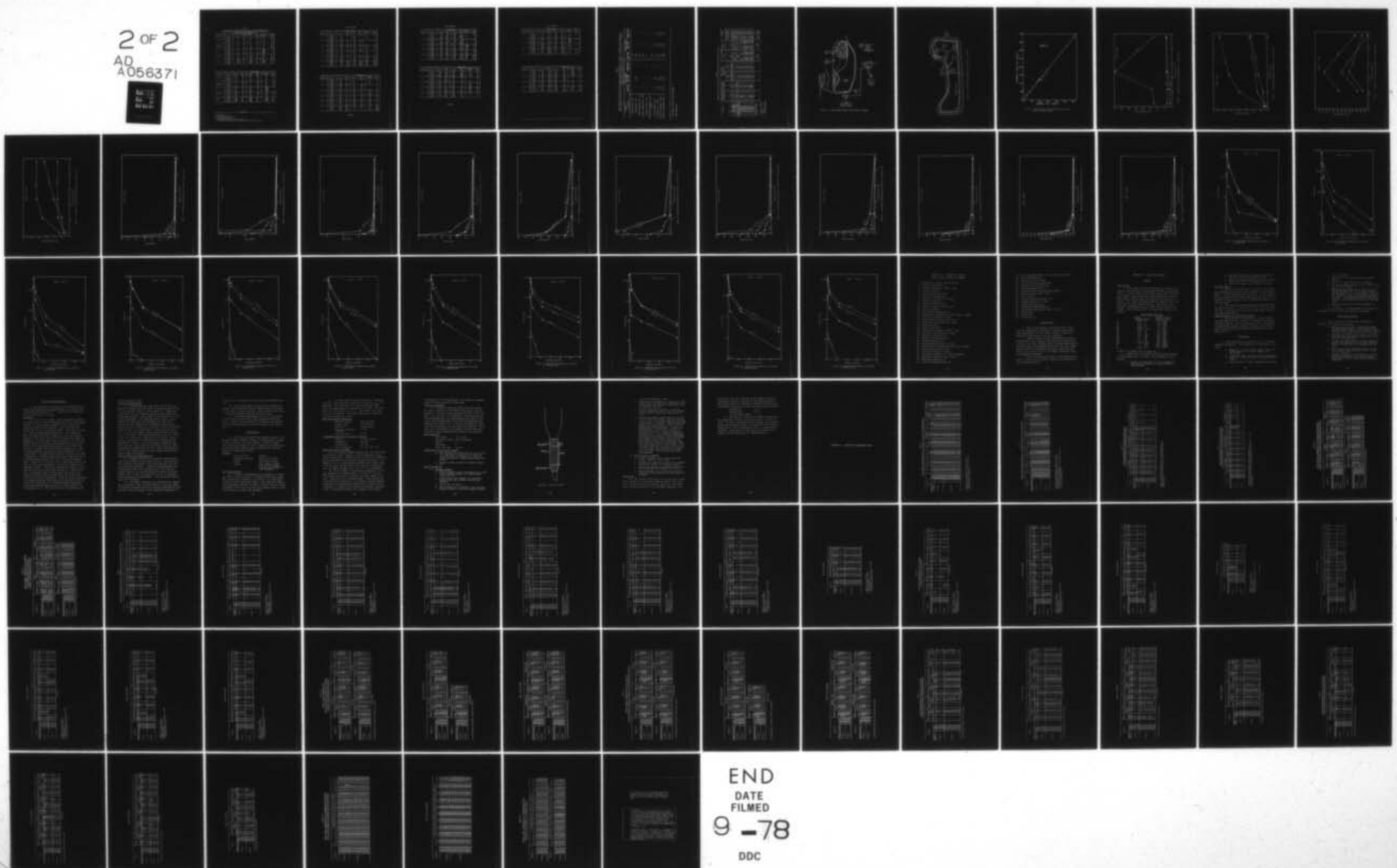

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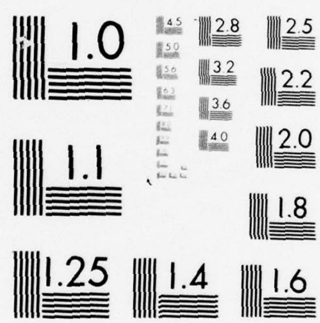

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

TABLE 6

SIZE FRACTIONATION OF CHEMICAL SPECIES IN INFLUENT, EFFLUENT, AND BACKGROUND WATER SAMPLES FROM THE PINTO ISLAND, MOBILE BAY, ALABAMA AND GRASSY ISLAND, DETROIT, MICHIGAN DREDGED MATERIAL DISPOSAL SITES

Parameters	Fractions *	PINTO ISLAND Influent	% OF TOTAL	Effluent	% OF TOTAL	Background Water	% OF TOTAL
Total Carbon	T (mg/l)	59	100	94	100	18.2	100
	A (mg/l)	38	64	53	56	12.3	68
	B (mg/l)	2	3	4	4	1.6	9
	C (mg/l)	19	33	37	40	4.3	24
Total Organic Carbon	T (mg/l)	19	100	40	100	7.2	100
	A (mg/l)	10	53	7	18	3.1	43
	B (mg/l)	0	0	1.5	3	1.4	19
	C (mg/l)	9	47	31.5	79	2.7	38
NH_3 - N	T (mg/l)	10.2	100	13.2	100	TRACE	100
	A (mg/l)	9.4	92	1.21	9	TRACE	•
	B (mg/l)	0	0	0.91	7	TRACE	•
	C (mg/l)	5.1	50	11.1	84	TRACE	•
Organic N	T (mg/l)	31.1	100	12.4	100	0.91	100
	A (mg/l)	9.05	29	5.50	44	0.24	26
	B (mg/l)	0	0	1.96	16	0.40	44
	C (mg/l)	23.6	76	4.94	40	0.27	30
Total P	T (mg/l)	74.3	100	42.5	100	0.19	100
	A (mg/l)	TRACE	~0	TRACE	~0	TRACE	~0
	B (mg/l)	TRACE	~0	TRACE	~0	TRACE	~0
	C (mg/l)	~4.3	~100	~42.5	~100	~0.19	~100

Parameters	Fractions *	GRASSY ISLAND INFLUENT	% OF TOTAL	EFFLUENT	% OF TOTAL	Background Water	% OF TOTAL
Total Carbon	T (mg/l)	214	100	96	100	38	100
	A (mg/l)	130	61	59	61	28	74
	B (mg/l)	36	17	9	9	1.5	4
	C (mg/l)	48	22	28	30	8.5	22
Total Organic Carbon	T (mg/l)	63	100	24	100	12	100
	A (mg/l)	19	30	14	58	3.0	25
	B (mg/l)	7	11	6	25	2.2	18
	C (mg/l)	37	59	4	17	6.8	57
NH_3 - N	T (mg/l)	83.8	100	14.2	100	TRACE	100
	A (mg/l)	41.0	49	12.8	90	TRACE	•
	B (mg/l)	0	0	0.40	3	TRACE	•
	C (mg/l)	43.1	51	1.00	7	TRACE	•
Organic N	T (mg/l)	60.5	100	2.57	100	1.10	100
	A (mg/l)	5.62	9	1.76	68	0.80	73
	B (mg/l)	1.15	2	0.22	9	0.16	15
	C (mg/l)	53.7	89	0.59	23	0.14	12
Total P	T (mg/l)	129	100	0.147	100	0.06	100
	A (mg/l)	TRACE	~0	TRACE	~0	TRACE	~0
	B (mg/l)	TRACE	~0	TRACE	~0	TRACE	~0
	C (mg/l)	~129	~100	~0.147	~100	~0.06	~100

(Continued)

*T = Total Slurry.
A = Soluble Fraction <0.05-μ.
B = Medium-Size Fraction, 0.05 to 8μ.
C = Settleable Fraction, >8-μ.
• = Cannot Determine Since Dealing with Trace Values.
— = Not Determined (Indicates Insufficient Sample or Sample Destroyed in Transit).

Table 6 (Continued)

		PINTO ISLAND					
Parameters	Fractions *	Influent	% OF TOTAL	Effluent	% OF TOTAL	Background Water	% OF TOTAL
Na	T (mg/l)	—	100	—	100	—	100
	A (mg/l)	7570	—	5850	—	1320	—
	B (mg/l)	890	—	880	—	0	—
	C (mg/l)	—	—	—	—	—	—
K	T (mg/l)	1630	100	745	100	—	100
	A (mg/l)	164	10	126	17	—	—
	B (mg/l)	20	1	10	1	—	—
	C (mg/l)	1446	89	609	82	—	—
Ca	T (mg/l)	668	100	513	100	68	100
	A (mg/l)	440	66	287	56	62.1	91
	B (mg/l)	30	4	40	8	3.7	5
	C (mg/l)	198	30	186	36	2.2	4
Mg	T (mg/l)	—	100	—	100	—	100
	A (mg/l)	1165	—	923	—	192	—
	B (mg/l)	166	—	139	—	30	—
	C (mg/l)	—	—	—	—	—	—
Cd	T (μg/l)	89	100	73	100	2.38	100
	A (μg/l)	2.69	3	2.01	3	0.67	28
	B (μg/l)	0.70	1	0.92	1	0.320	13
	C (μg/l)	85.6	96	70.1	96	1.39	59
Cu	T (mg/l)	2.73	100	1.31	100	0.43	100
	A (μg/l)	3.11	0.10	4.51	0.30	1.86	0.40
	B (μg/l)	1.48	0.05	0.93	0.07	0.13	0.03
	C (mg/l)	∿2.73	∿99.85	∿1.31	∿99.63	∿0.43	∿99.57

		GRASSY ISLAND					
Parameters	Fractions *	Influent	% OF TOTAL	Effluent	% OF TOTAL	Background Water	% OF TOTAL
Na	T (mg/l)	235	100	—	100	—	100
	A (mg/l)	20.8	9	22.8	—	13.0	—
	B (mg/l)	3.7	2	6.0	—	16.5	—
	C (mg/l)	210	89	—	—	—	—
K	T (mg/l)	886	100	345	100	—	100
	A (mg/l)	129	15	113	33	—	—
	B (mg/l)	19	2	10	3	—	—
	C (mg/l)	738	83	222	64	—	—
Ca	T (mg/l)	62.4	100	35.0	100	4.51	100
	A (mg/l)	46.4	74	27.2	78	3.42	76
	B (mg/l)	3.3	5	3.6	10	10.0	22
	C (mg/l)	12.7	21	4.2	12	0.09	2
Mg	T (mg/l)	174	100	156	100	9.2	100
	A (mg/l)	72.0	41	32.9	21	8.9	97
	B (mg/l)	15.8	9	5.3	3	0	0
	C (mg/l)	86.0	50	118	76	0.4	3
Cd	T (μg/l)	435	100	1.86	100	1.27	100
	A (μg/l)	3.67	1	0.70	38	0.09	7
	B (μg/l)	1.45	0.5	0.18	10	0.03	2
	C (μg/l)	430	98.5	0.97	52	1.15	91
Cu	T (mg/l)	22.4	100	1.62	100	0.27	100
	A (μg/l)	9.60	0.04	4.43	0.3	2.3	0.90
	B (μg/l)	2.60	0.01	1.17	0.1	0.3	0.10
	C (mg/l)	∿22.4	∿99.95	—	—	∿0.27	∿99.00

(Continued)

Table 6 (Continued)

Parameters	Fractions *	PINTO ISLAND Influent	% OF TOTAL	Effluent	% OF TOTAL	Background Water	% OF TOTAL
Fe	T (mg/l)	2290	100	1230	100	—	100
	A (μg/l)	102	0.004	13.8	0.001	1.2	—
	B (μg/l)	116	0.005	81.7	0.007	3.1	—
	C (mg/l)	∿2290	∿100	∿1230	∿100	—	—
Mn	T (mg/l)	45.4	100	21	100	2.3	100
	A (μg/l)	4.72	0.01	3.58	0.02	—	—
	B (μg/l)	0.35	0.0001	0.29	0.001	—	—
	C (mg/l)	∿45.4	∿100	∿21	∿99.98	—	—
Hg	T (μg/l)	34	100	22	100	TRACE	100
	A (μg/l)	0.22	0.6	0.17	0.8	0.030	•
	B (μg/l)	0.06	0.2	0.02	0.1	0.005	•
	C (μg/l)	33.7	99.2	21.8	99.1	0	0
Ni	T (mg/l)	1.83	100	0.60	100	0.004	100
	A (μg/l)	7.54	0.40	6.55	1	3.02	76
	B (μg/l)	0.90	0.05	1.24	0.2	0.45	11
	C (mg/l)	1.82	99.55	0.59	98	0.53	13
Pb	T (mg/l)	5.22	100	3.40	100	0.44	100
	A (μg/l)	5.49	0.1	3.85	0.1	1.04	0.2
	B (μg/l)	1.05	0.02	0.79	0.02	0.41	0.1
	C (mg/l)	∿5.22	∿99.88	∿3.40	∿99.88	∿0.44	∿99.7

Parameters	Fractions *	GRASSY ISLAND Influent	% OF TOTAL	Effluent	% OF TOTAL	Background Water	% OF TOTAL
Fe	T (mg/l)	5620	100	46.8	100	0.03	100
	A (μg/l)	87.8	0.002	4.00	0.009	4.3	14
	B (μg/l)	603	0.01	2.44	0.005	9.2	30
	C (mg/l)	∿5620	∿99.99	∿46.8	∿99.99	0.017	56
Mn	T (mg/l)	26.1	100	0.60	100	—	100
	A (μg/l)	76	0.3	49	8	2	—
	B (μg/l)	11	0.04	13	2	0	—
	C (mg/l)	∿26.1	∿99.66	0.54	90	—	—
Hg	T (μg/l)	84.8	100	3.1	100	1.0	100
	A (μg/l)	0.13	0.2	0.13	4	0.05	5
	B (μg/l)	0.11	0.1	0.11	3	0.02	2
	C (μg/l)	84.6	99.7	2.86	93	0.93	93
Ni	T (mg/l)	11.5	100	0.53	100	0.004	100
	A (μg/l)	14.0	0.1	12.3	2	2.2	55
	B (μg/l)	1.2	0.01	1.7	0.3	0.57	15
	C (mg/l)	∿11.5	∿99.89	∿0.53	∿97.7	1.17	30
Pb	T (mg/l)	12.3	100	0.105	100	0.047	100
	A (μg/l)	5.22	0.04	5.99	4.5	1.1	2
	B (μg/l)	0.77	0.01	0.56	0.5	—	—
	C (mg/l)	∿12.3	∿99.95	0.100	95	—	—

(Continued)

Table 6 (Concluded)

Parameters	Fractions *	PINTO ISLAND Influent	% OF TOTAL	Effluent	% OF TOTAL	Background Water	% OF TOTAL
Se	T (mg/l)	3.10	100	1.89	100	—	100
	A (μg/l)	4.47	0.1	2.40	0.1	0.49	—
	B (μg/l)	0	0	0.45	0.02	0.04	—
	C (mg/l)	∿3.10	∿99.90	∿1.89	∿99.88	—	—
Ti	T (mg/l)	5.24	100	2.74	100	TRACE	100
	A (μg/l)	4.48	0.1	2.88	0.1	TRACE	•
	B (μg/l)	0	0	0.28	0.01	TRACE	•
	C (mg/l)	∿5.24	∿99.90	∿2.74	∿99.89	TRACE	•
V	T (mg/l)	3.68	100	2.02	100	—	100
	A (μg/l)	6.58	0.2	3.79	0.2	TRACE	—
	B (μg/l)	0.98	0.03	0.33	0.02	TRACE	—
	C (mg/l)	∿3.68	∿99.77	∿2.02	∿99.78	—	—
Zn	T (mg/l)	16.4	100	10.7	100	1.12	100
	A (μg/l)	0.30	0.002	1.04	0.01	0.94	0.1
	B (μg/l)	1.25	0.008	0.15	0.001	0	0
	C (mg/l)	∿16.4	∿99.99	∿10.7	∿99.99	∿1.12	∿99.90

Parameters	Fractions *	GRASSY ISLAND Influent	% OF TOTAL	Effluent	% OF TOTAL	Background Water	% OF TOTAL
Se	T (mg/l)	4.95	100	0.157	100	0.008	100
	A (μg/l)	1.00	0.02	0.32	0.2	TRACE	∿0
	B (μg/l)	0.90	0.02	0.35	0.2	TRACE	∿0
	C (mg/l)	∿4.95	∿99.96	∿0.157	∿99.60	∿0.008	∿100
Ti	T (mg/l)	8.30	100	0.26	100	TRACE	100
	A (μg/l)	1.51	0.02	1.43	0.6	—	—
	B (μg/l)	0.47	0.01	0.10	0.04	—	—
	C (mg/l)	∿8.30	∿99.97	∿0.26	∿99.36	—	—
V	T (mg/l)	5.44	100	0.21	100	0.003	100
	A (μg/l)	2.60	0.05	1.89	1	—	—
	B (μg/l)	0.85	0.02	0.96	0.5	—	—
	C (mg/l)	∿5.44	∿99.93	∿0.21	∿98.50	2.89	96
Zn	T (mg/l)	24.2	100	0.48	100	0.23	100
	A (μg/l)	100	0.4	1.54	0.3	2.00	1
	B (μg/l)	109	0.5	0.30	0.06	0.19	0.1
	C (mg/l)	24.0	99.10	∿0.48	∿99.64	∿0.23	∿98.9

TABLE 7

Concentrations and Ratios of Petroleum Hydrocarbons of Influent, Effluent and Background Water Samples for Pinto Island (Mobile Bay, Alabama) and Grassy Island (Detroit, Michigan) Dredged Material Disposal Areas

Sample ID / * Parameters	Pinto Island			Grassy Island		
	Influent INF - 1D	Effluent EFF - 3D	Background W BW - D	Influent INF - 2D	Effluent EFF - 1D	Background W BW - A
Phenanthrene, µg/l	—	—	—	1.10	—	—
Naphthalene, µg/l	—	0.03	—	0.05	—	—
Methyl-Naphthalene, µg/l	—	—	—	0.24	—	—
Dimethyl-Naphthalene, µg/l	—	—	—	1.30	—	—
Automatic Total, µg/l	<1	<1	<1	2.7	<1	<1
Naphthalene-Phenanthrene Ratio	—	—	—	0.05	—	—
Total Alkanes, µg/l	6	29	<1	6	29	<1
Pristane to C_{17} Ratio	2.0	3.0	—	0.10	0.30	0.67
Pristane to Phytane Ratio	2.00	0.60	—	1.33	1.33	3.00
Normal to Branched Ratio	0.76	0.10	—	0.08	0.07	1.16

* Analyzed on Total (Slurry) Sample.

— None Detected.

TABLE 8

COMPARISON OF PINTO ISLAND AND GRASSY ISLAND EFFLUENTS WITH MARINE WATER CRITERIA

Parameters	Proposed EPA Marine Water Quality (1973) (9)	Proposed NAS Marine Water Quality (1973) (9)	Ocean Discharge Standards of California (1972) (8)		Effluents				Background Water (0.05-μ Filtrate)	
					Pinto Island		Grassy Island			
			50% of time	10% of time	*	**	*	**	Pinto Island	Grassy Island
pH	6.5-8.5	6.5-8.5	<0.2 changes	<0.2 changes	7.8 •		8.3 •		7.6 •	7.3 •
D.O. (mg/l)	6	—	<10% changes	<10% changes	2.4 Δ		7.3 Δ		7.6 Δ	7.0 Δ
NH_3-N (mg/l)	0.4	0.4	—	—	1.21	13.2	12.8	14.2	trace	trace
NO_3-N (mg/l)	—	—	—	—	0.23	—	0.11	—	0.09 •	0.10 •
P (mg/l)	0.01	0.005	—	—	trace	42.50	trace	0.147	trace	trace
Oil and Grease (mg/l)	not visible	not visible	10	15	45		15		3.5	32
Suspended Solids (mg/l)	—	—	50	75	80		6		10	trace
As (μg/l)	200	200	10	20	—	—	—	—	—	—
Cd (μg/l)	100	10	20	30	2.0	73	0.7	1.86	0.67	0.09
Cr (μg/l)	100	50	5	10	—	—	—	—	—	—
Cu (μg/l)	—	—	200	300	4.51	1310	4.43	1620	1.86	2.3
Fe (μg/l)	300	100	—	—	13.8	1.2×10^6	4.00	46,800	1.2	4.3
Pb (μg/l)	—	50	100	200	3.85	3400	5.99	105	1.04	1.1
Mn (μg/l)	—	—	100	100	3.58	21000	49	600	—	2
Hg (μg/l)	100	100	1	2	0.17	22	0.13	3.1	0.03	0.05
Ni (μg/l)	100	1000	100	200	6.55	600	12.3	530	3.02	2.2
V (μg/l)	500	500	—	—	3.79	2020	1.89	210	trace	—
Zn (μg/l)	100	—	300	500	1.04	10,700	1.54	480	0.94	2.0
Total Chlorinated Hydrocarbons (μg/l)	—	—	2	4	448 settleable		1320 setteable		9 settle-able	540 settle-able

* Soluble (<0.05-μ).
** Total.
• 0.45-μ Filtrates.
Δ Field Data Averages.

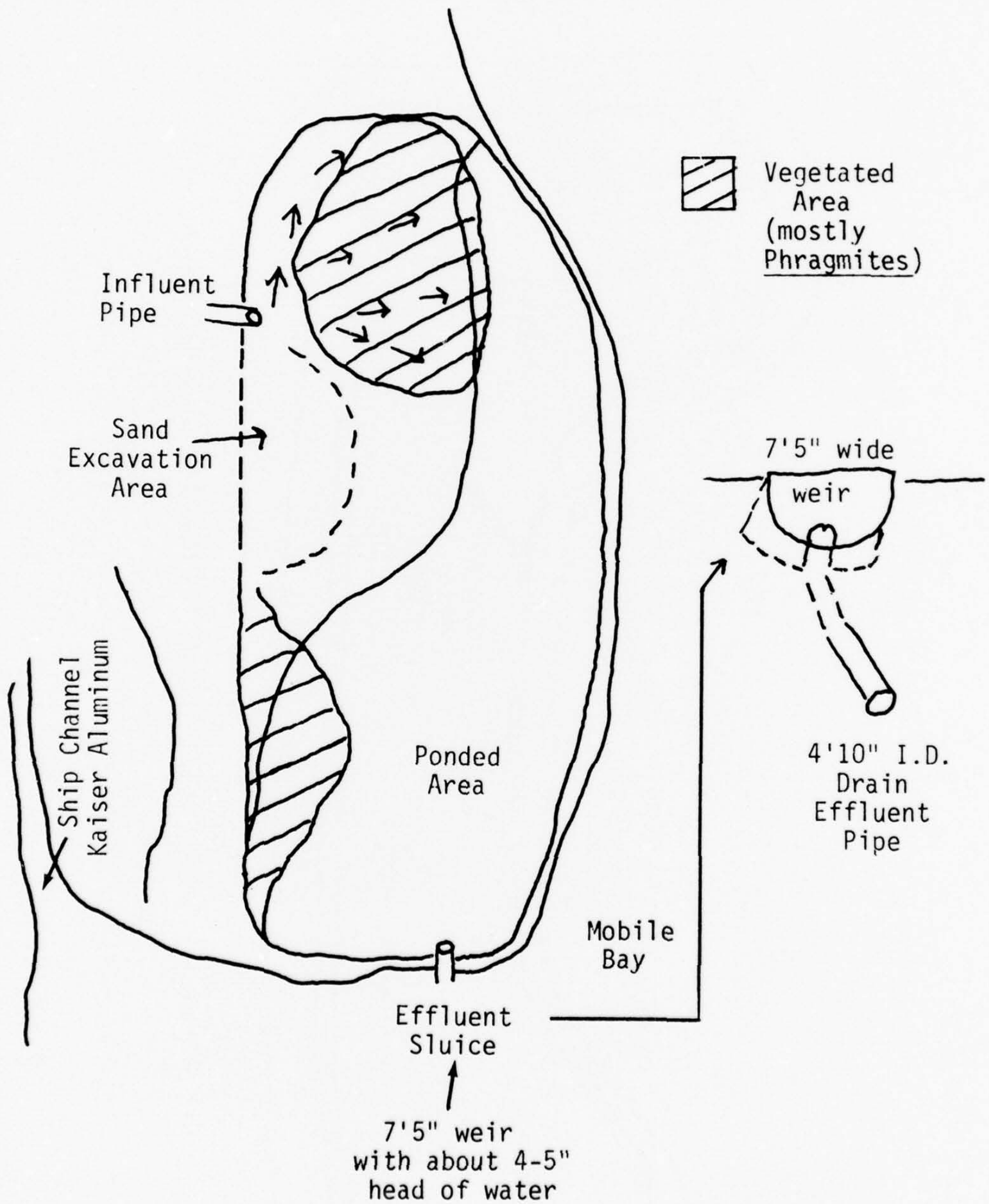

Figure 1. Pinto Island Disposal Site, Mobile, Alabama.

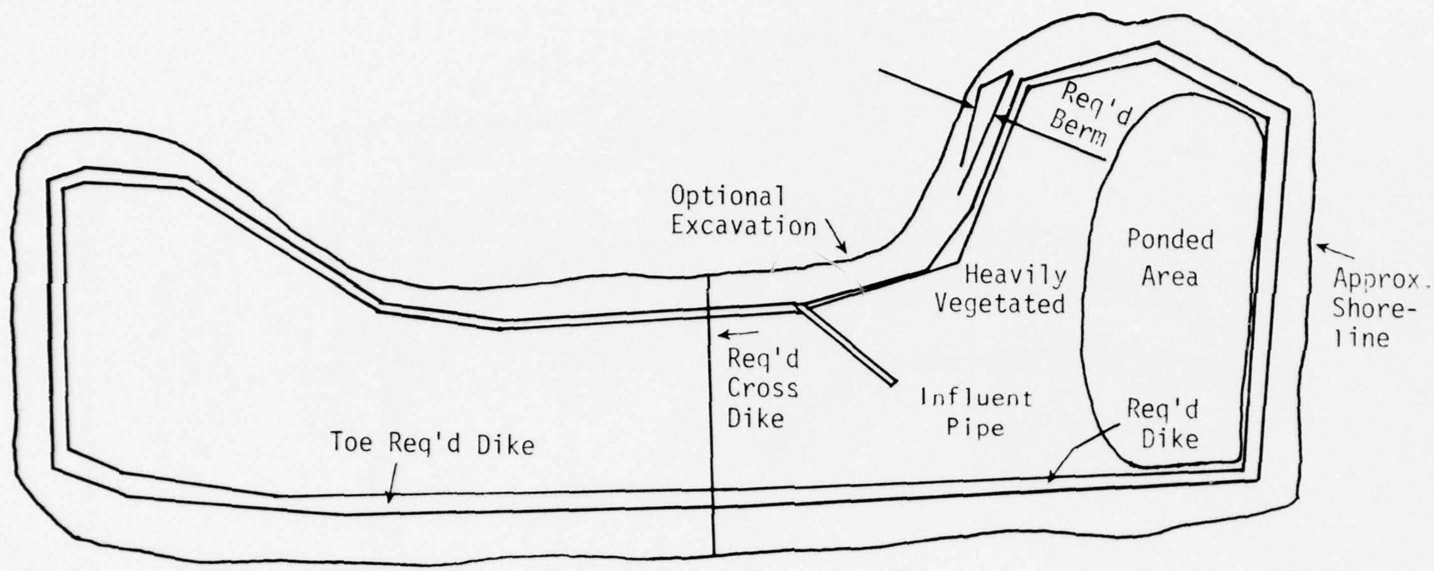

Figure 2. Grassy Island Disposal Site, Detroit, Michigan.

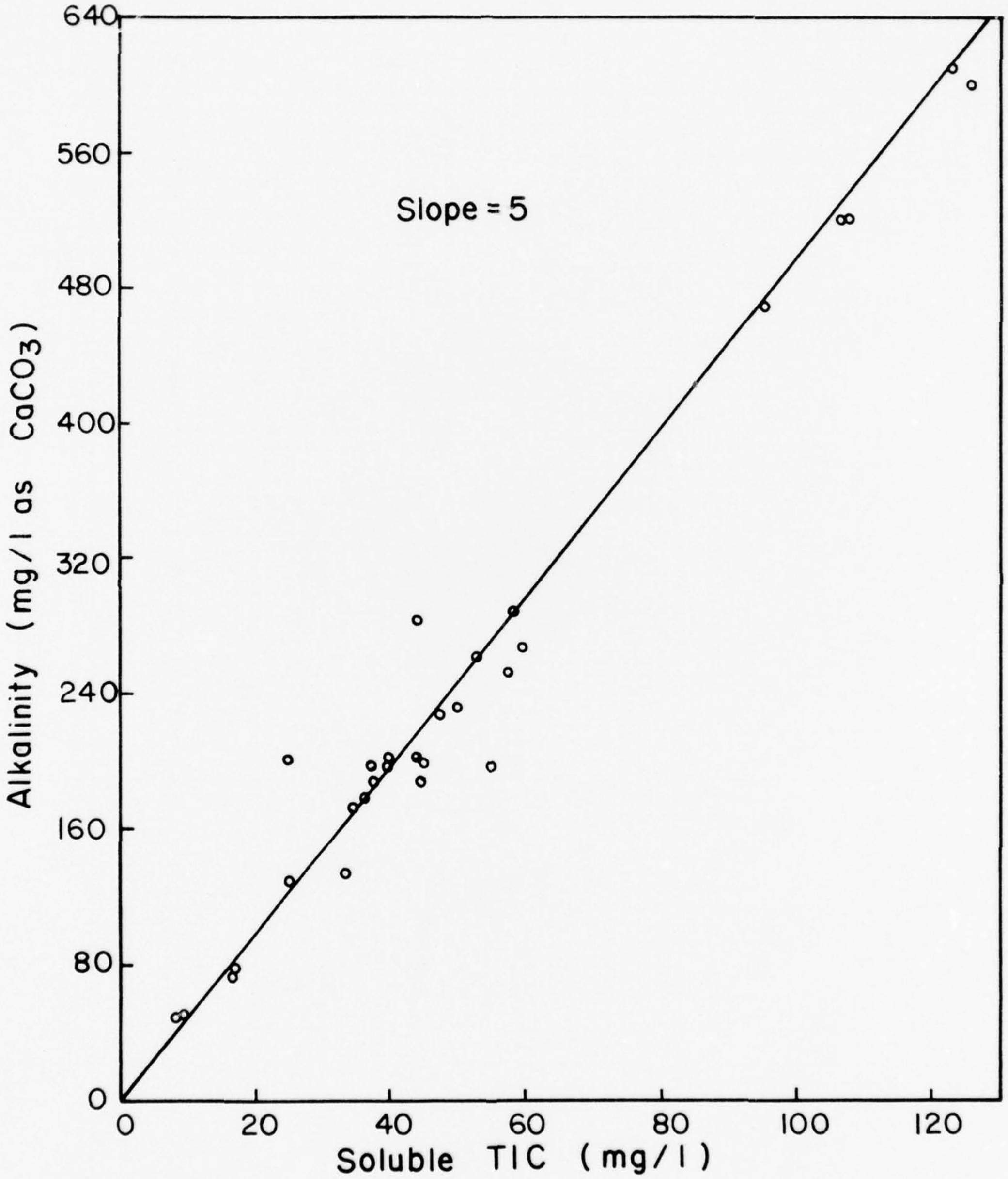

Figure 3. Relationships between Alkalinity and Total Soluble Inorganic Carbon.

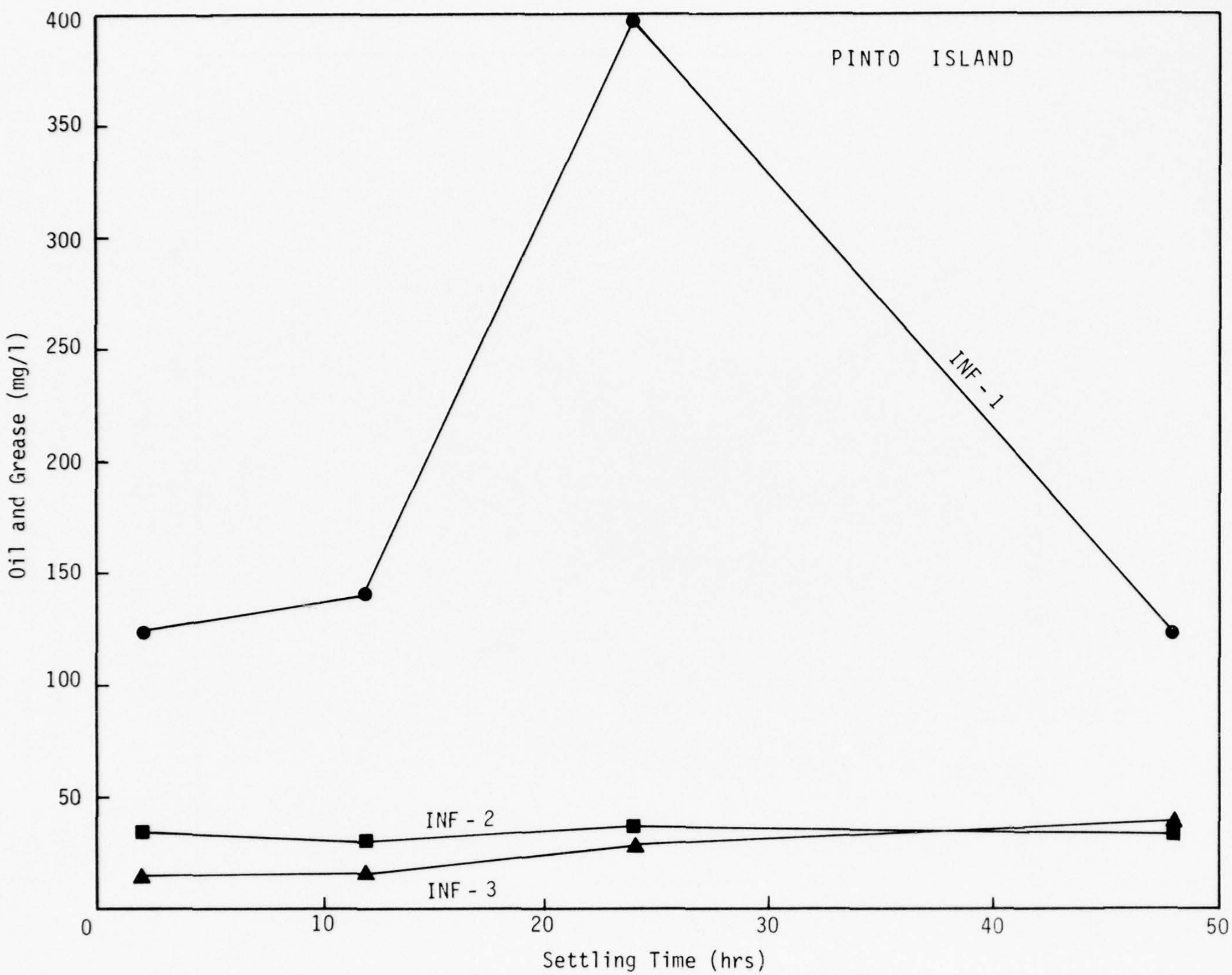

Figure 4. Influent Oil and Grease Concentration vs. Settling Time.

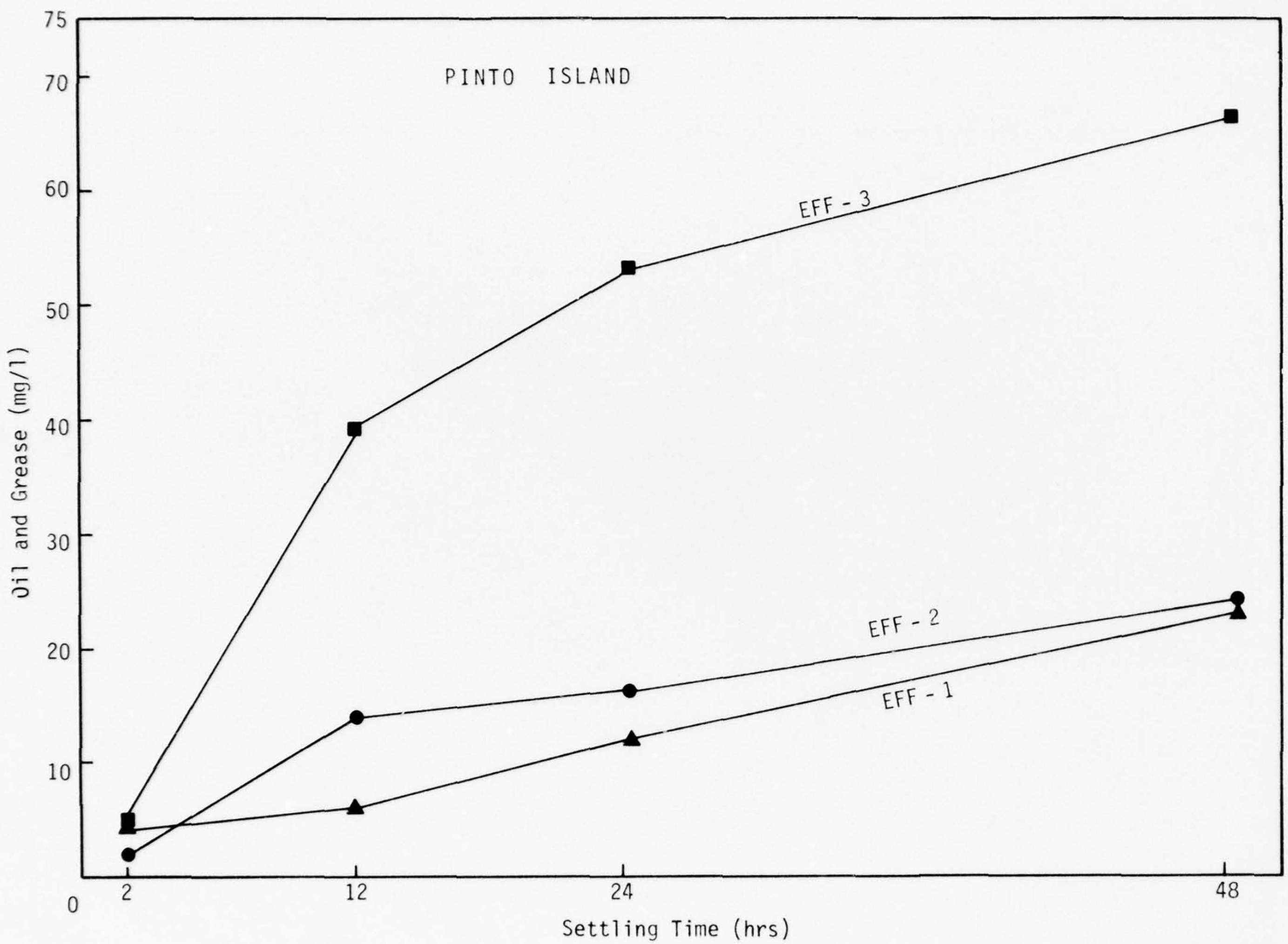

Figure 5. Effluent Oil and Grease Concentration vs Settling Time.

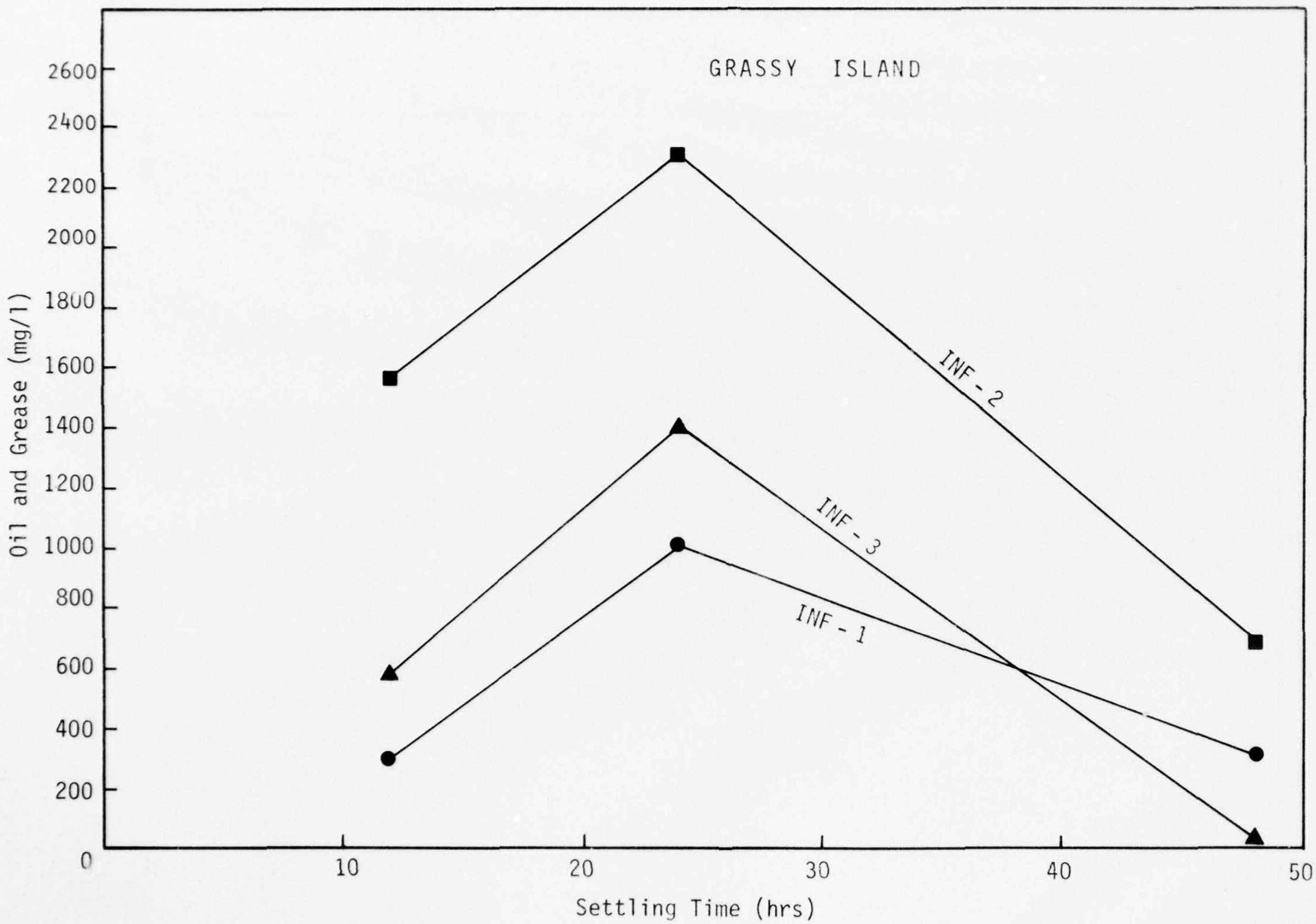

Figure 6. Influent Oil and Grease Concentration vs. Settling Time.

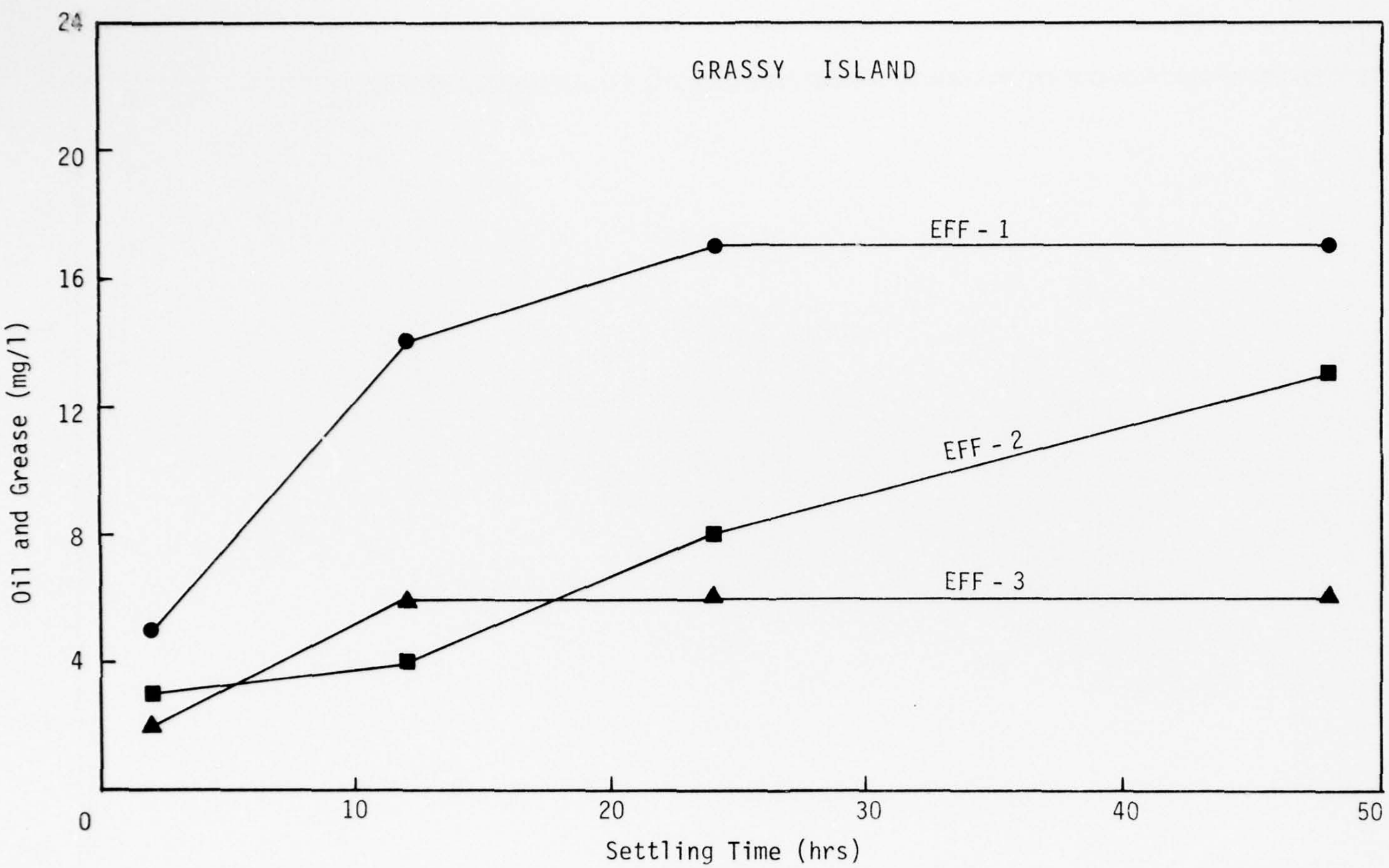

Figure 7. Effluent Oil and Grease Concentration vs. Settling Time.

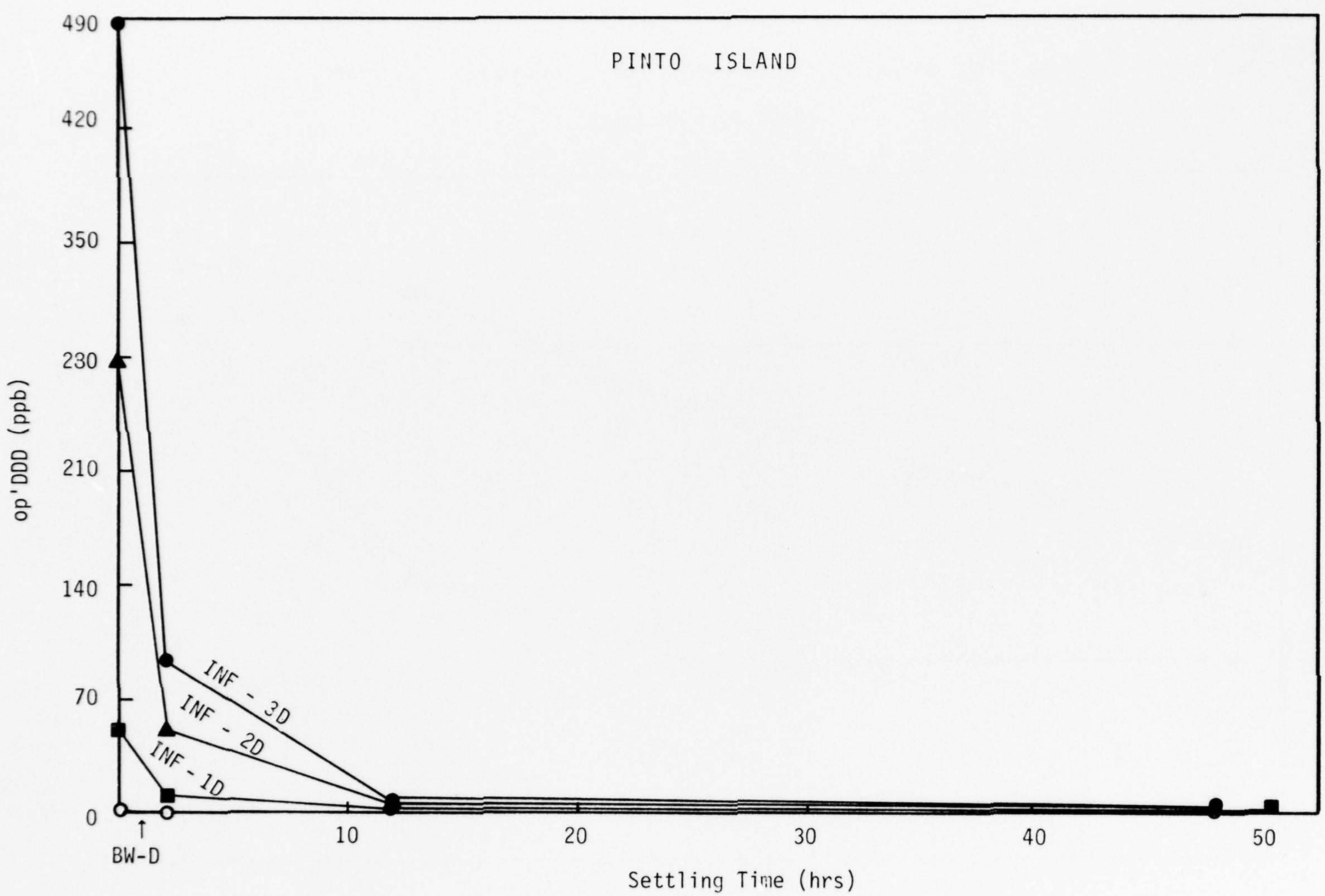

Figure 8. Supernatant Concentration of op'DDD vs. Settling Time.

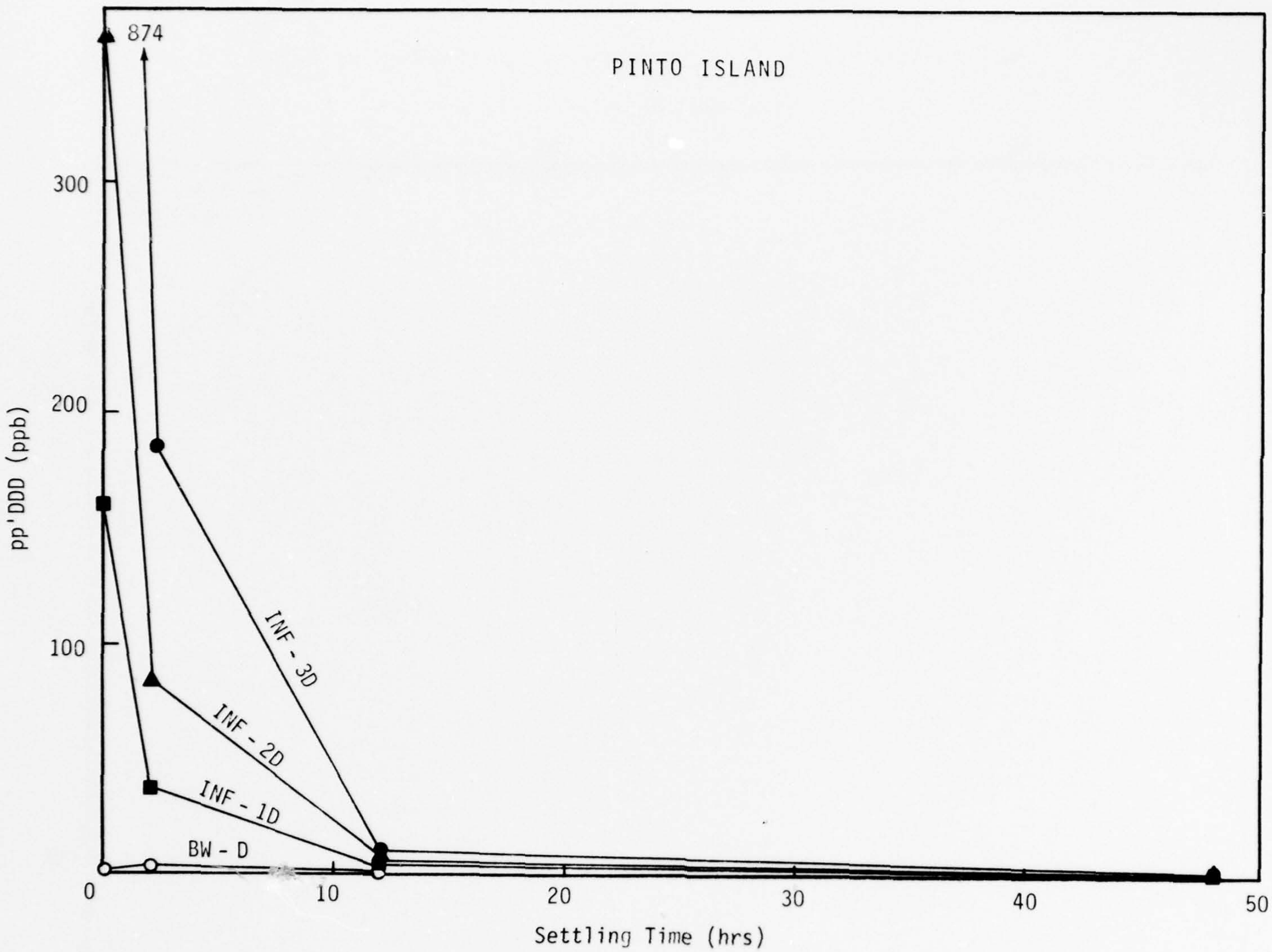

Figure 9. Supernatant Concentration of pp'DDD vs. Settling Time.

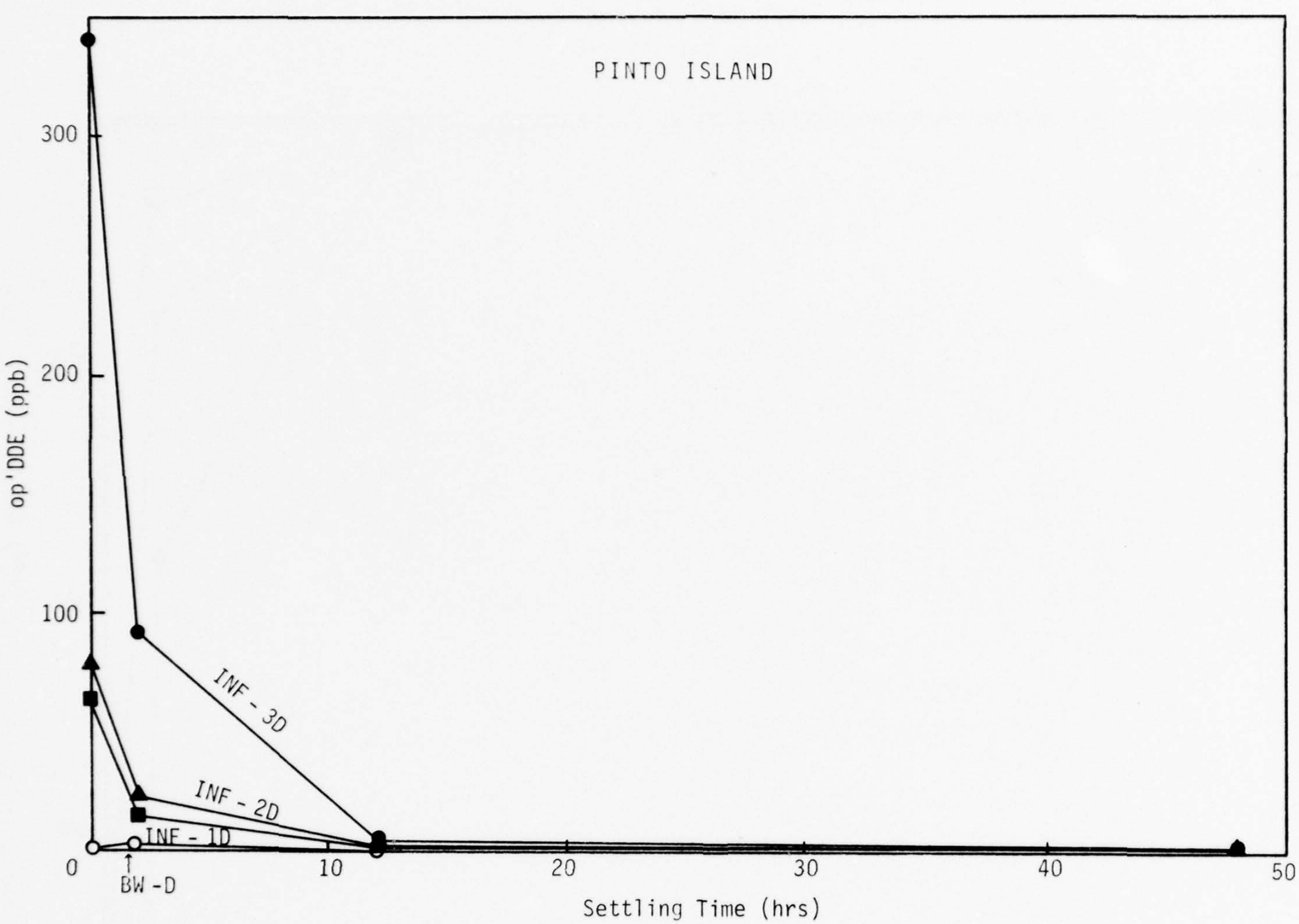

Figure 10. Supernatant Concentration of op'DDE vs. Settling Time.

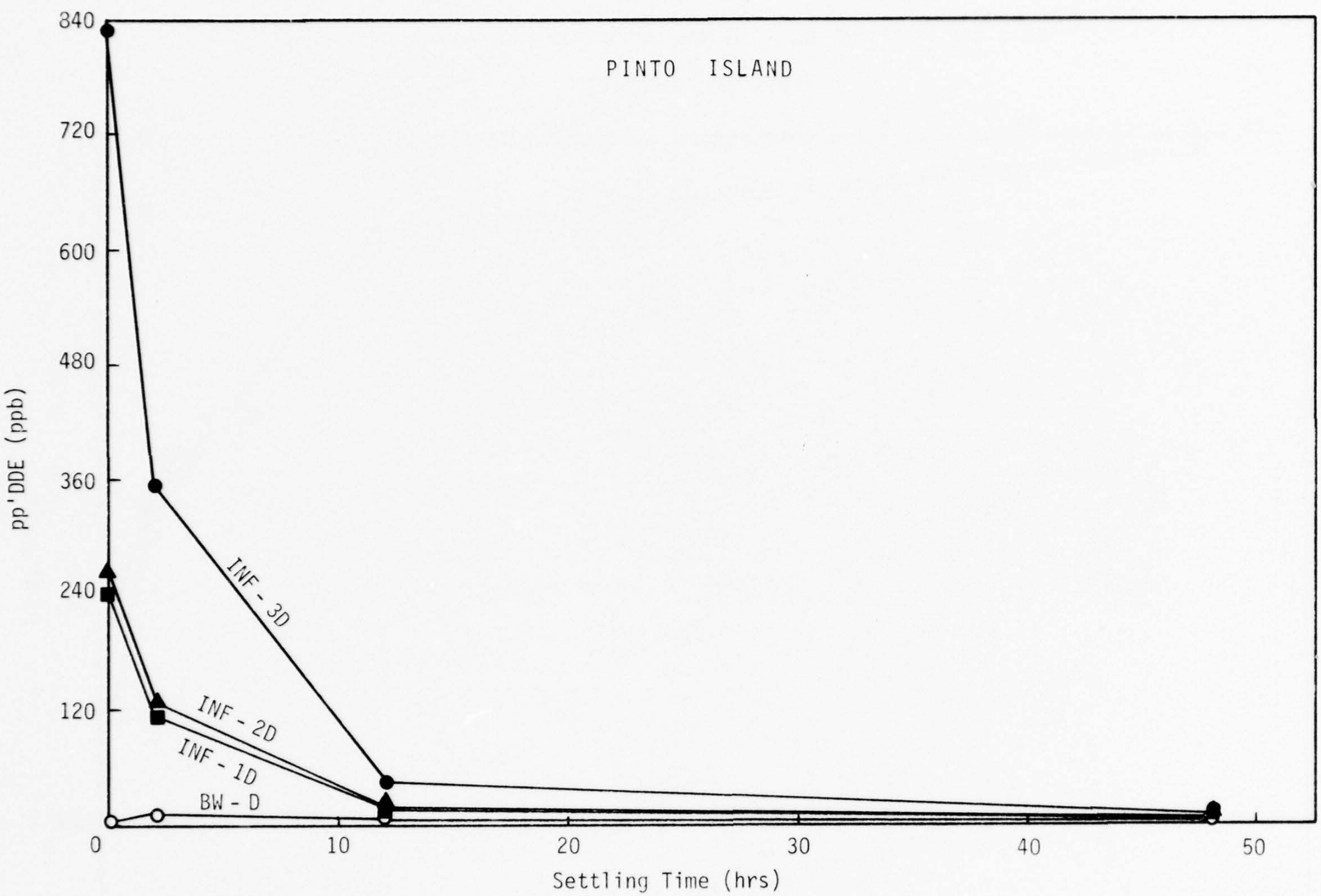

Figure 11. Supernatant Concentration of pp'DDE vs. Settling Time.

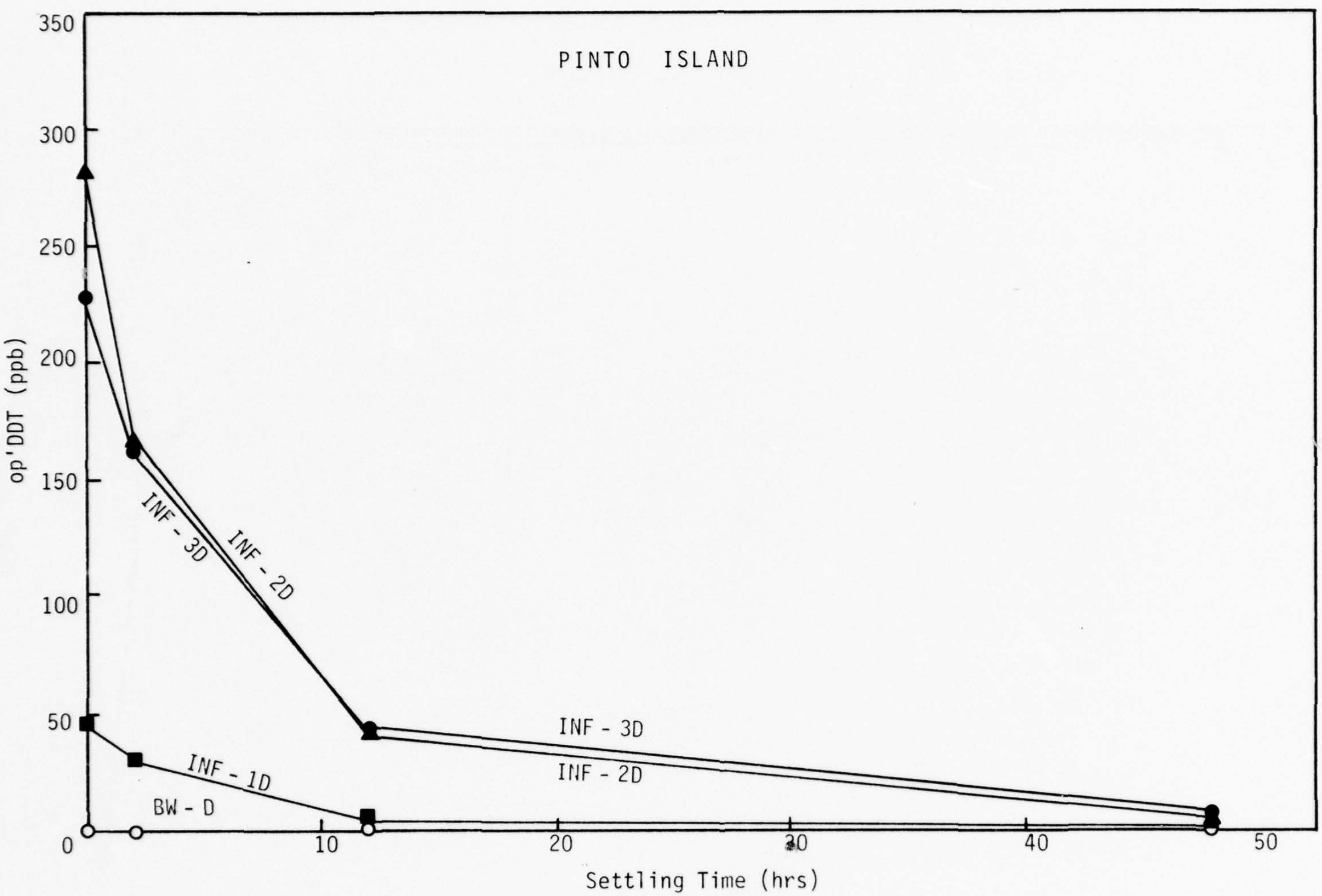

Figure 12. Supernatant Concentration of op'DDT vs. Settling Time.

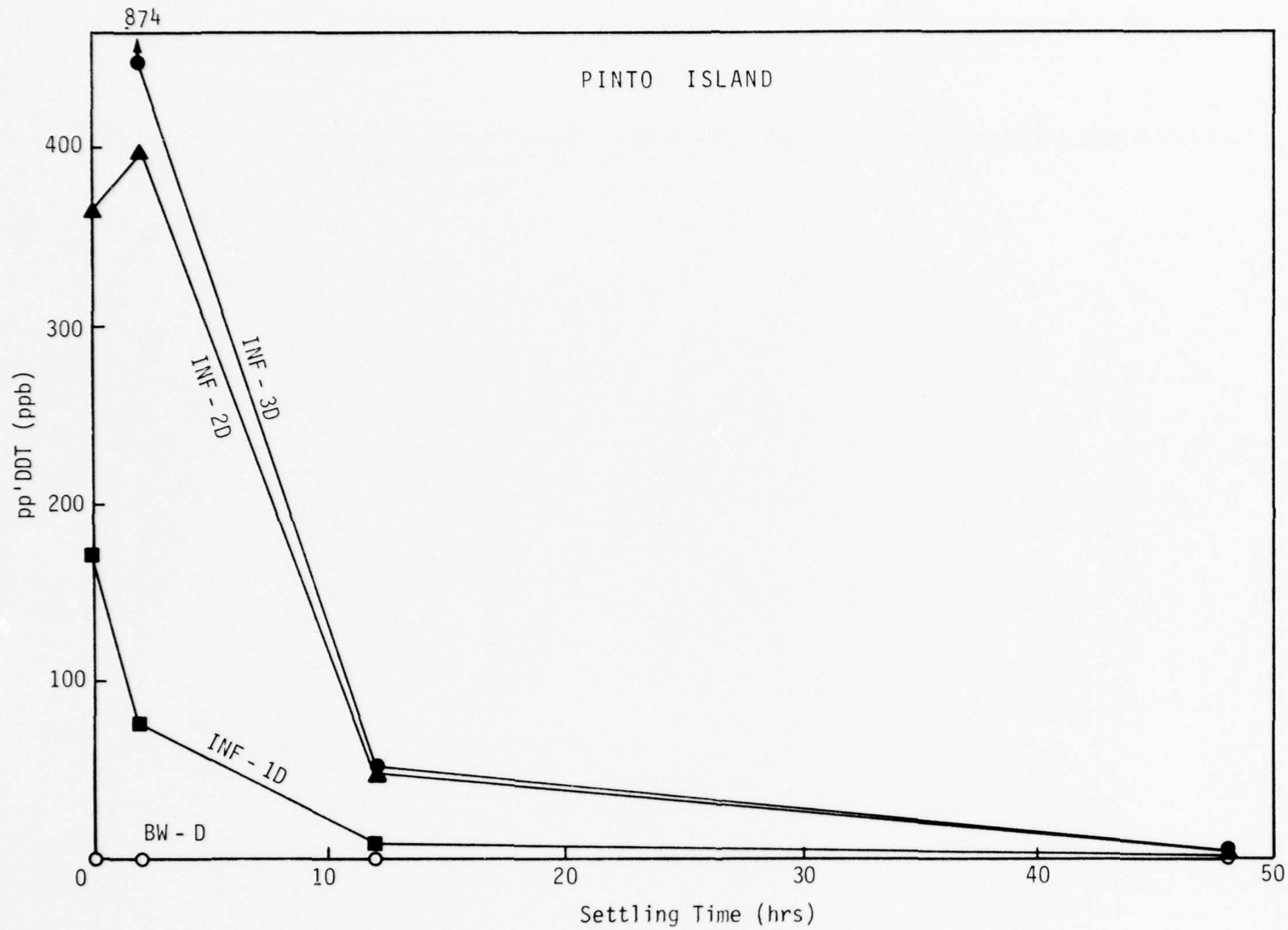

Figure 13. Supernatant Concentration of pp'DDT vs. Settling Time.

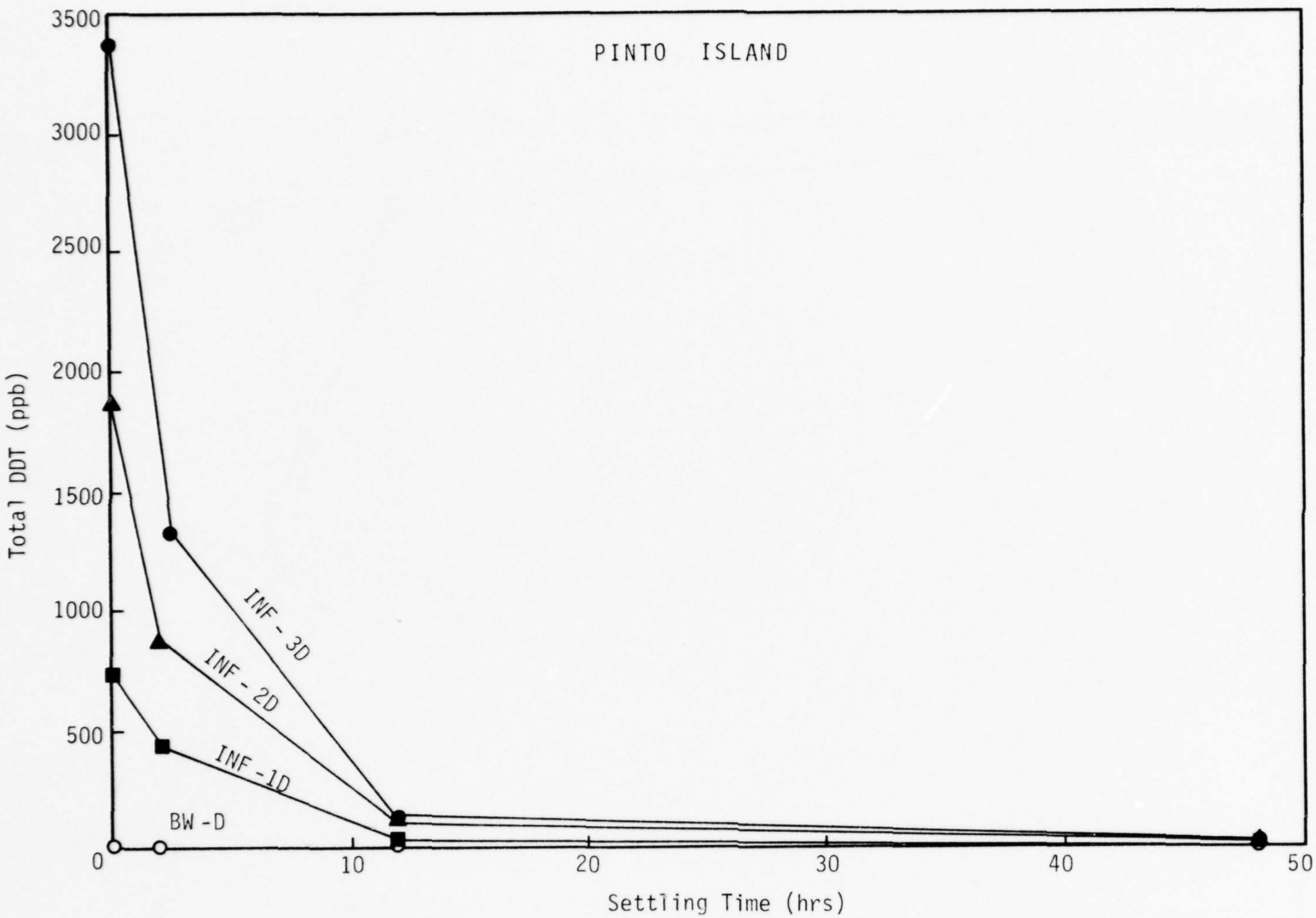

Figure 14. Supernatant Concentration of Total DDT vs. Settling Time.

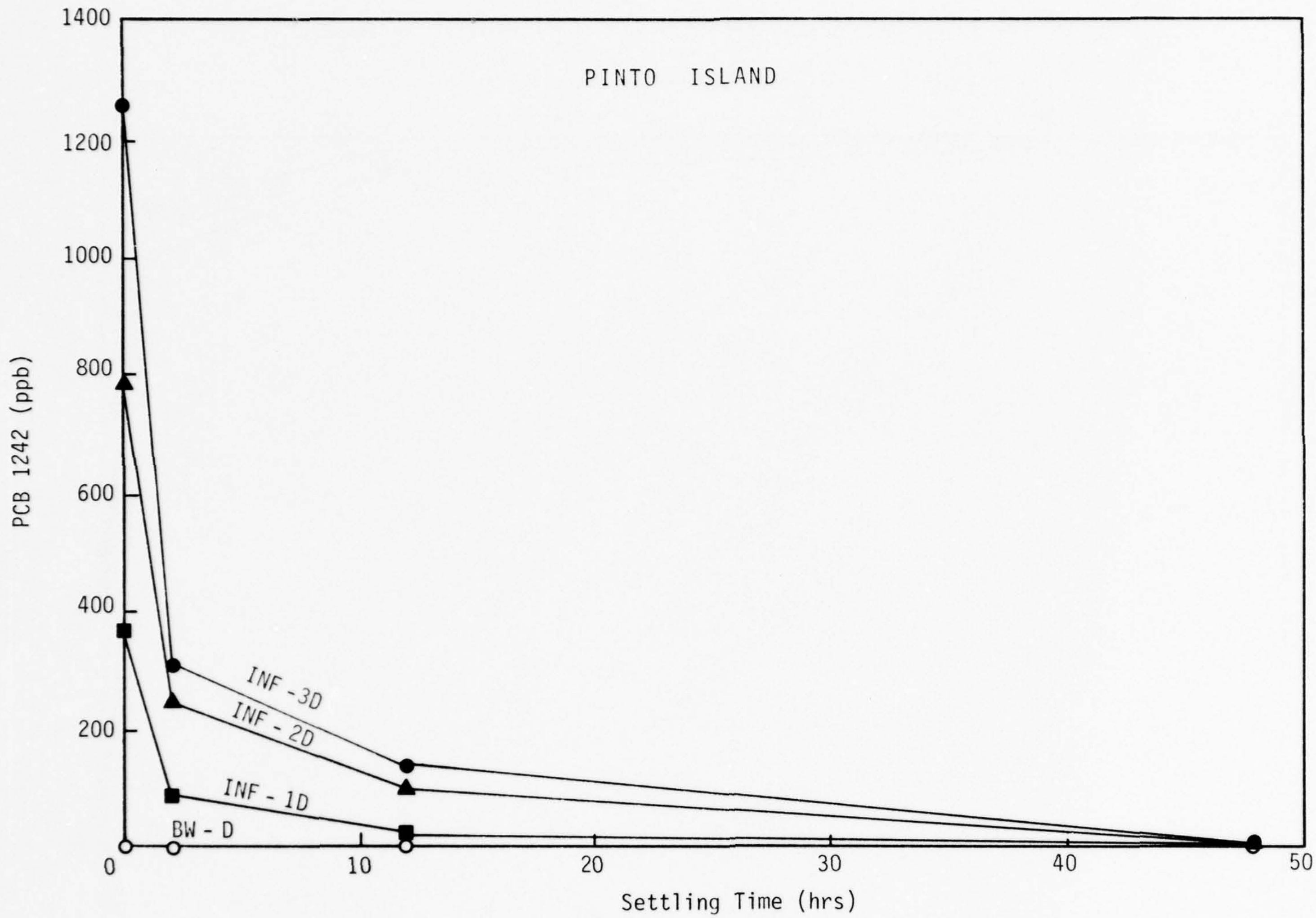

Figure 15. Supernatant Concentration of PCB 1242 vs. Settling Time.

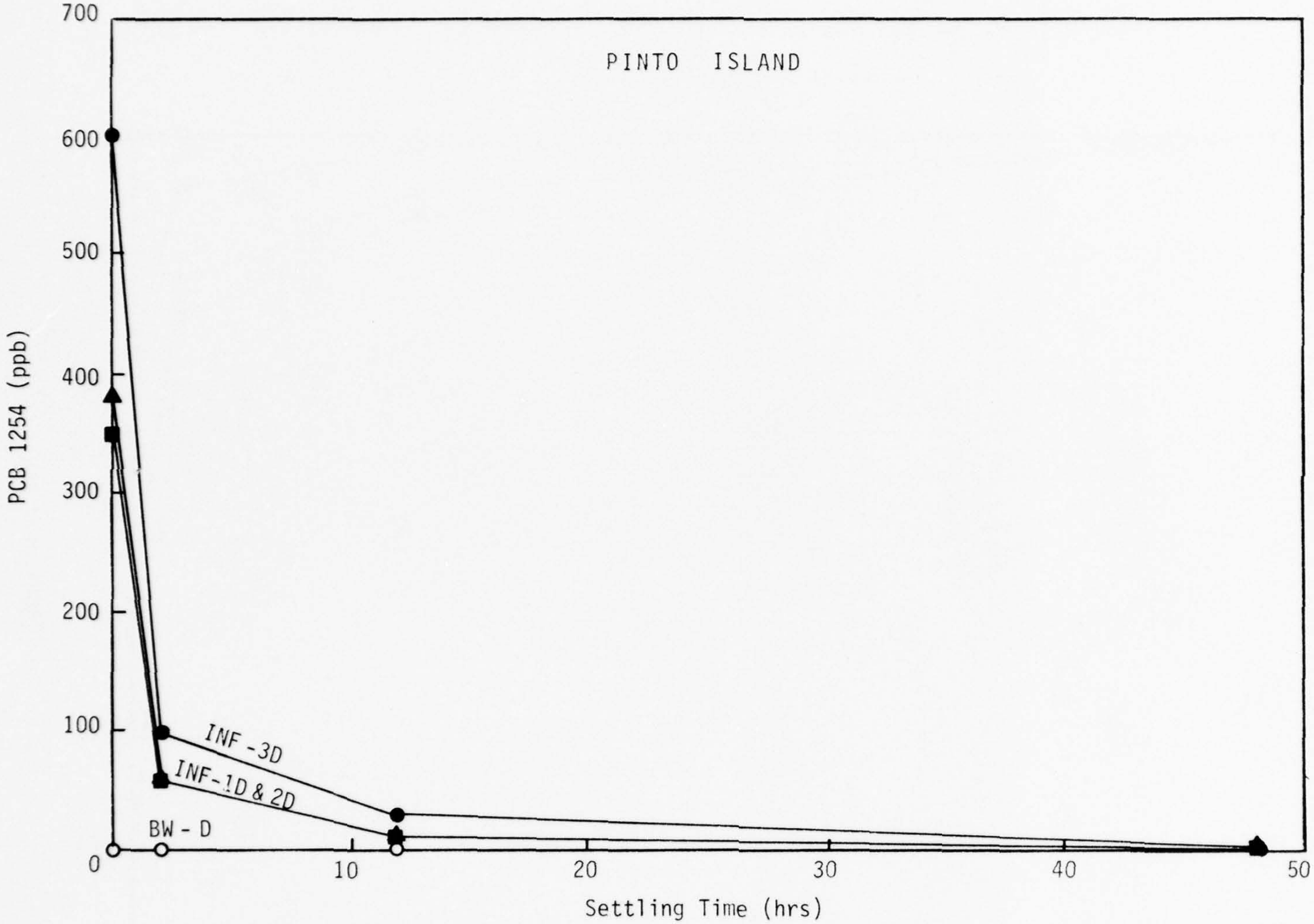

Figure 16. Supernatant Concentration of PCB 1254 vs. Settling Time.

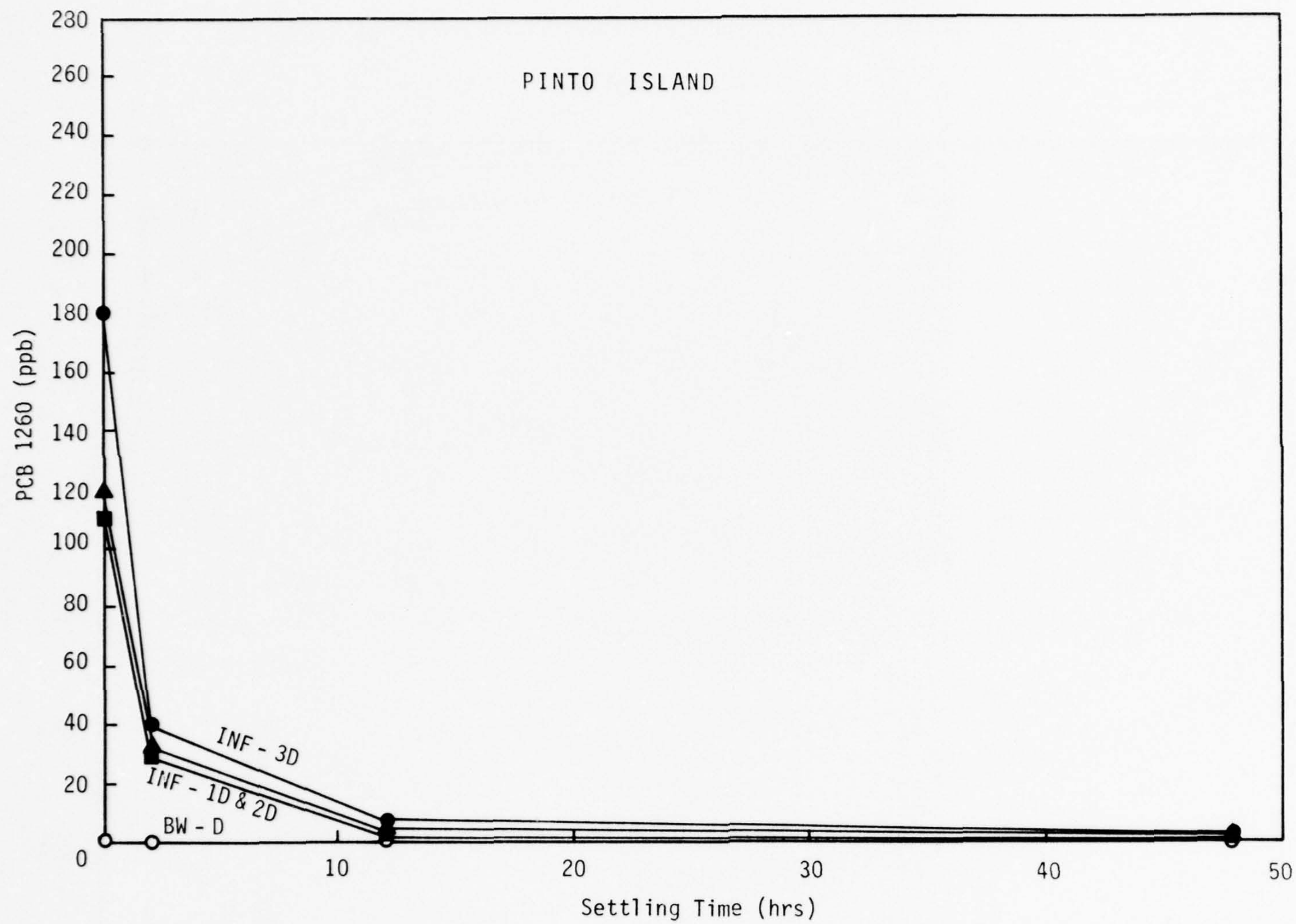

Figure 17. Supernatant Concentration of PCB 1260 vs. Settling Time.

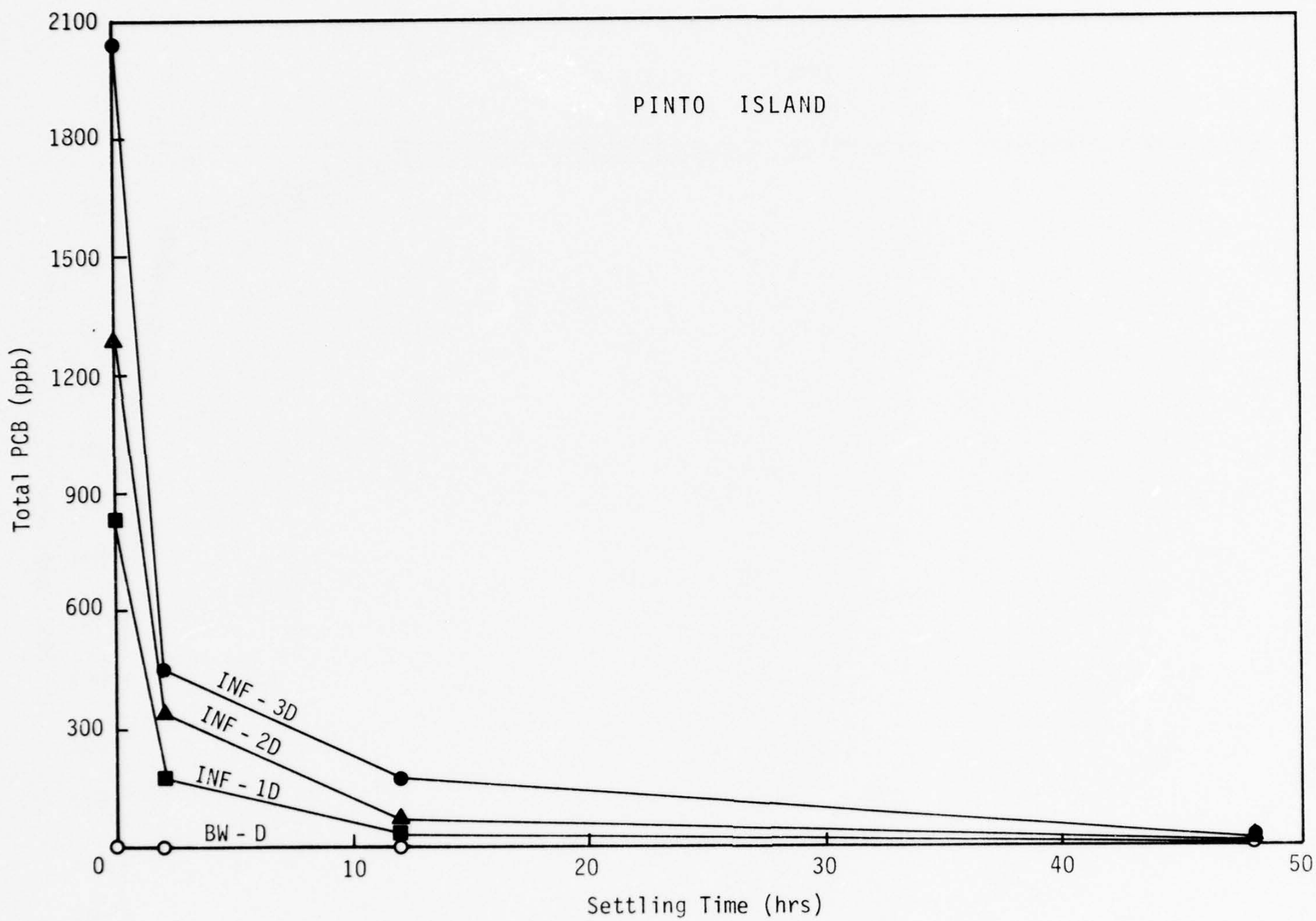

Figure 18. Supernatant Concentration of Total PCB vs. Settling Time.

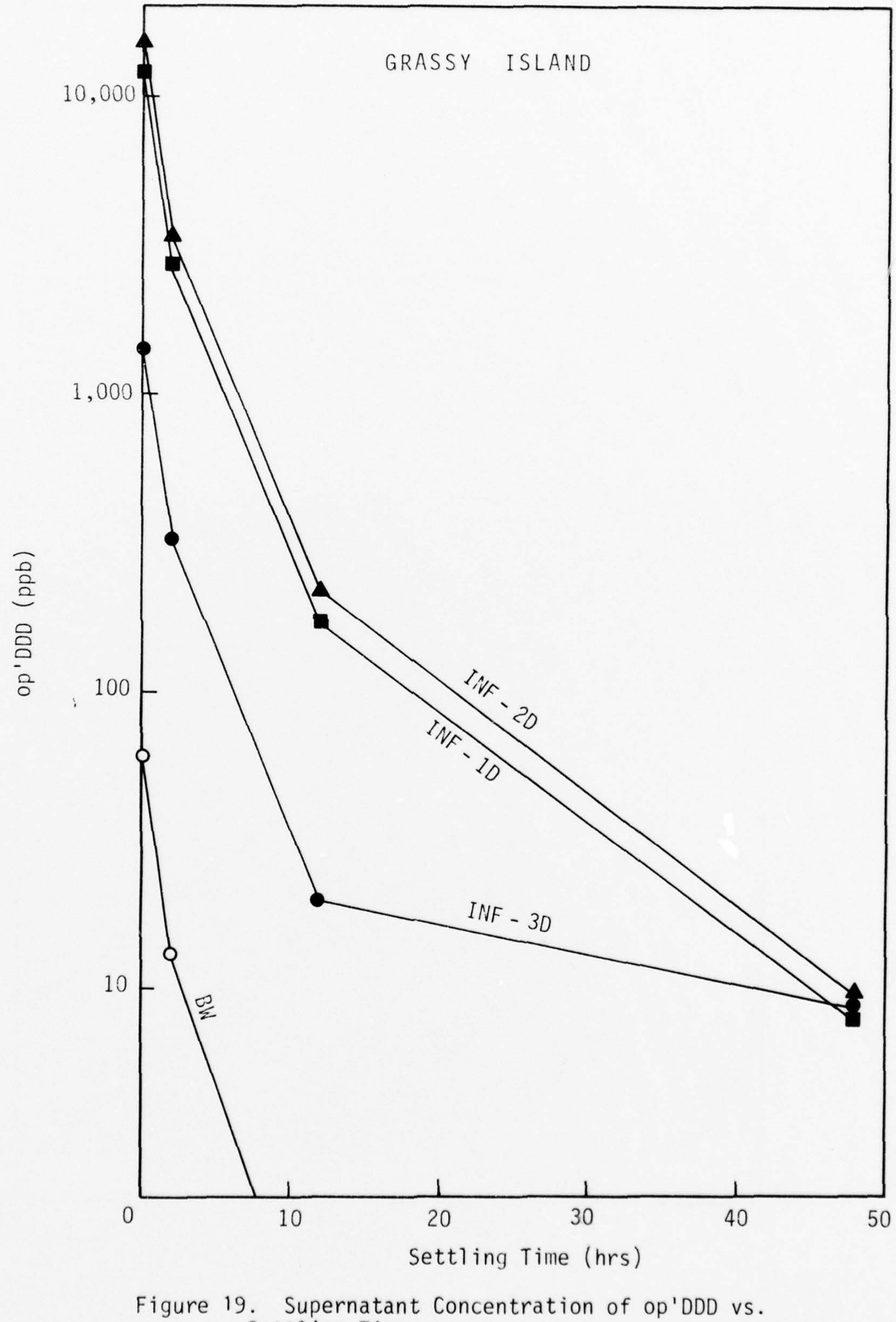

Figure 19. Supernatant Concentration of op'DDD vs. Settling Time.

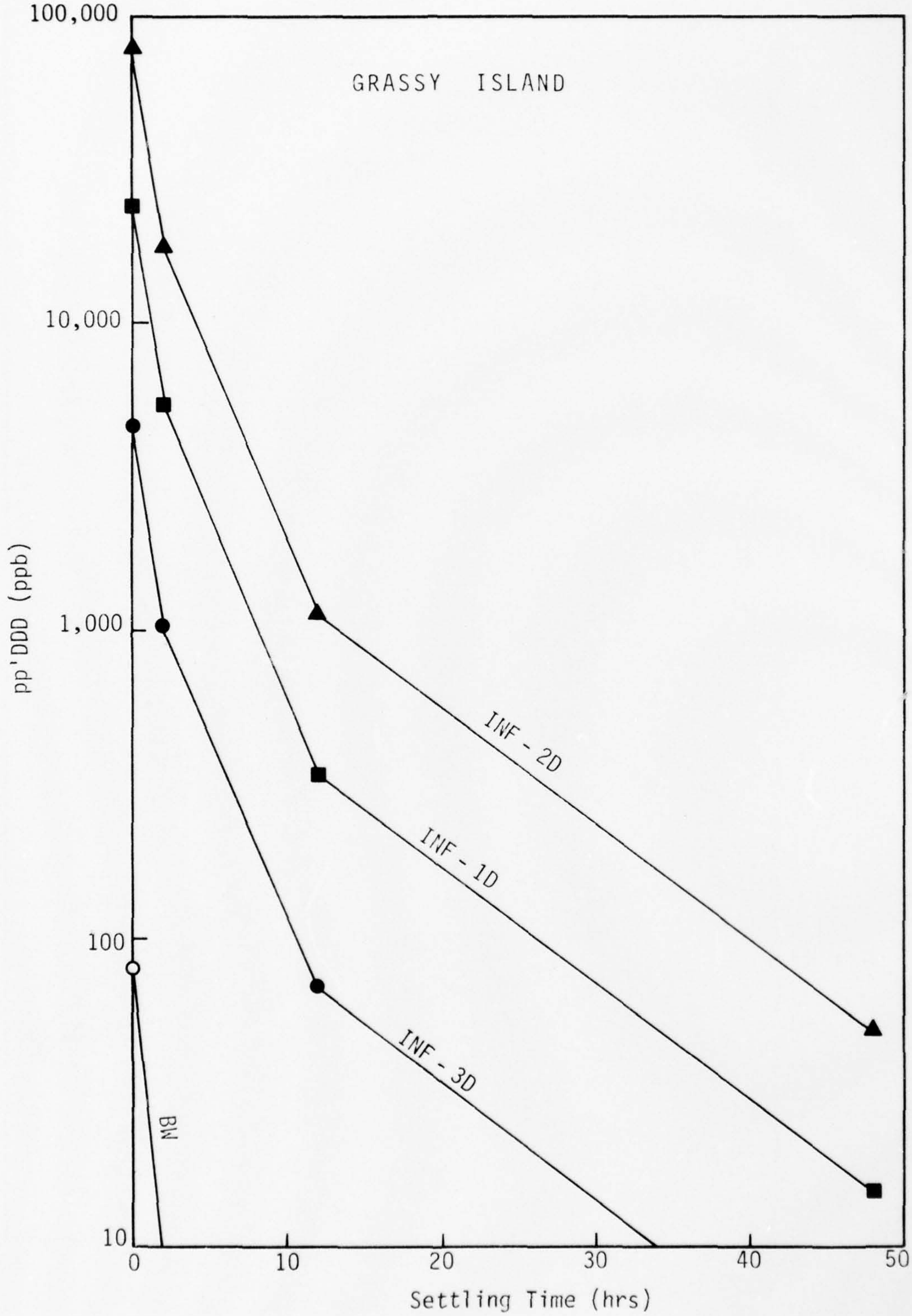

Figure 20. Supernatant Concentration of pp'DDD vs. Settling Time.

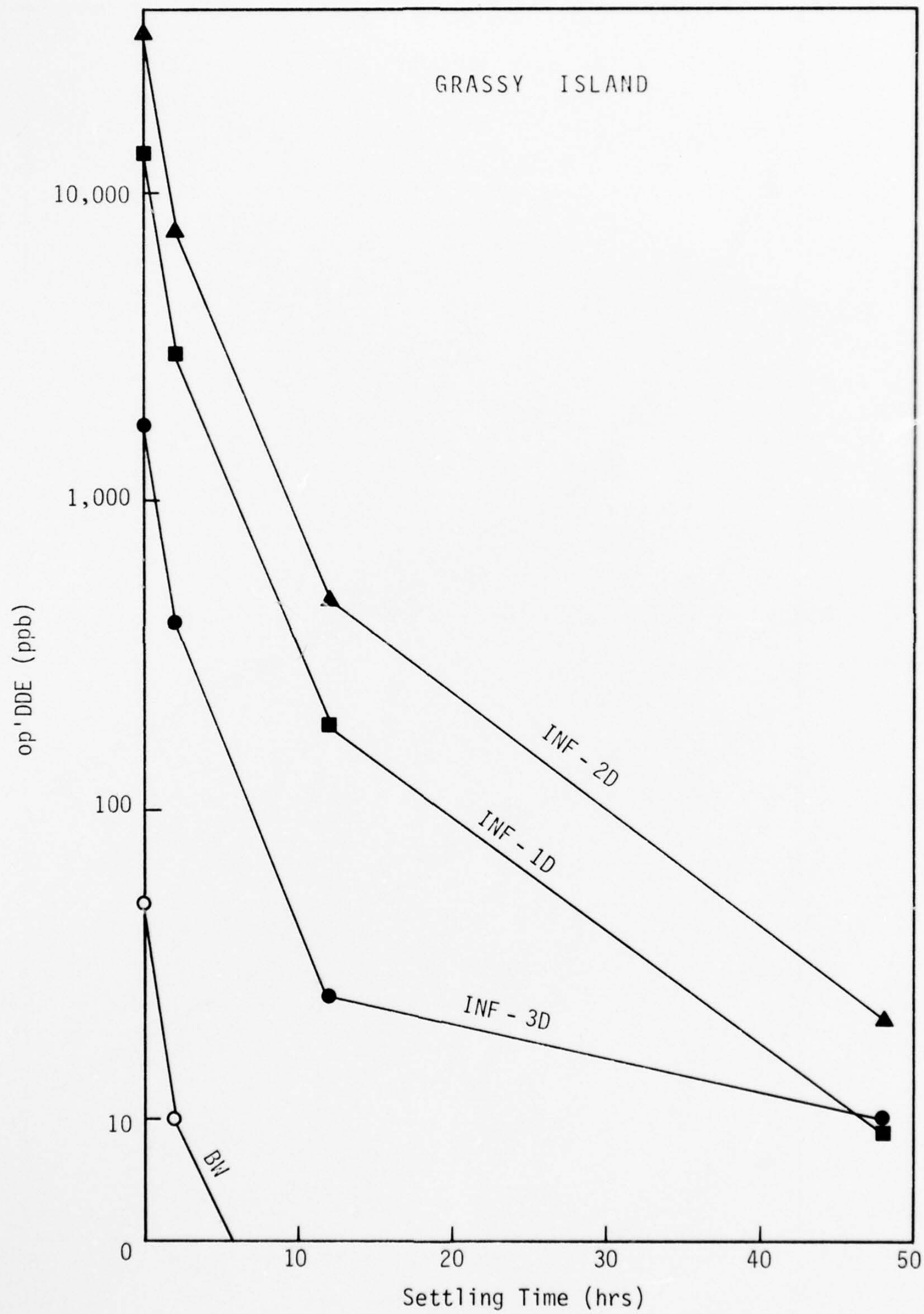

Figure 21. Supernatant Concentration of op'DDE vs. Settling Time.

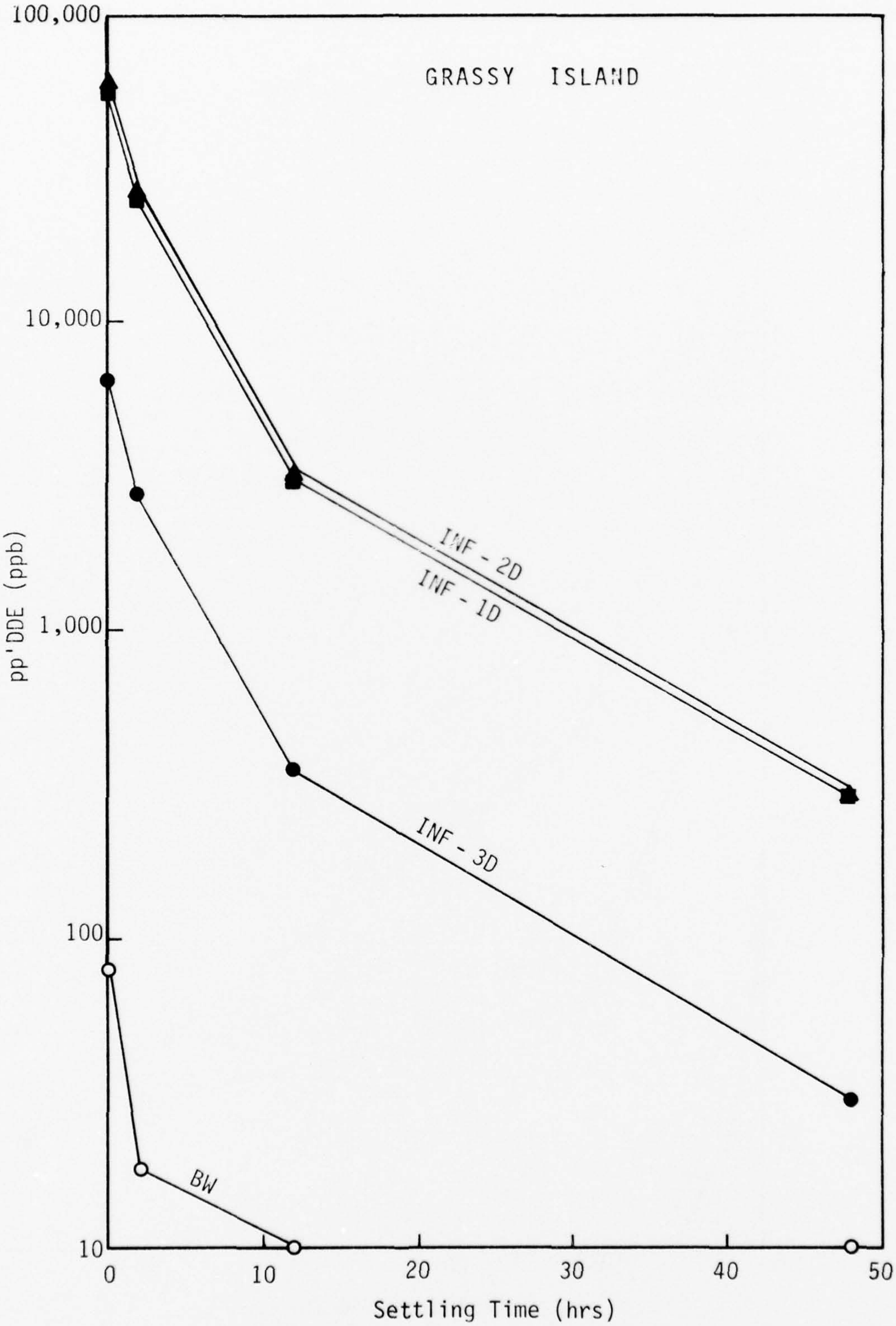

Figure 22. Supernatant Concentration of pp'DDE vs. Settling Time.

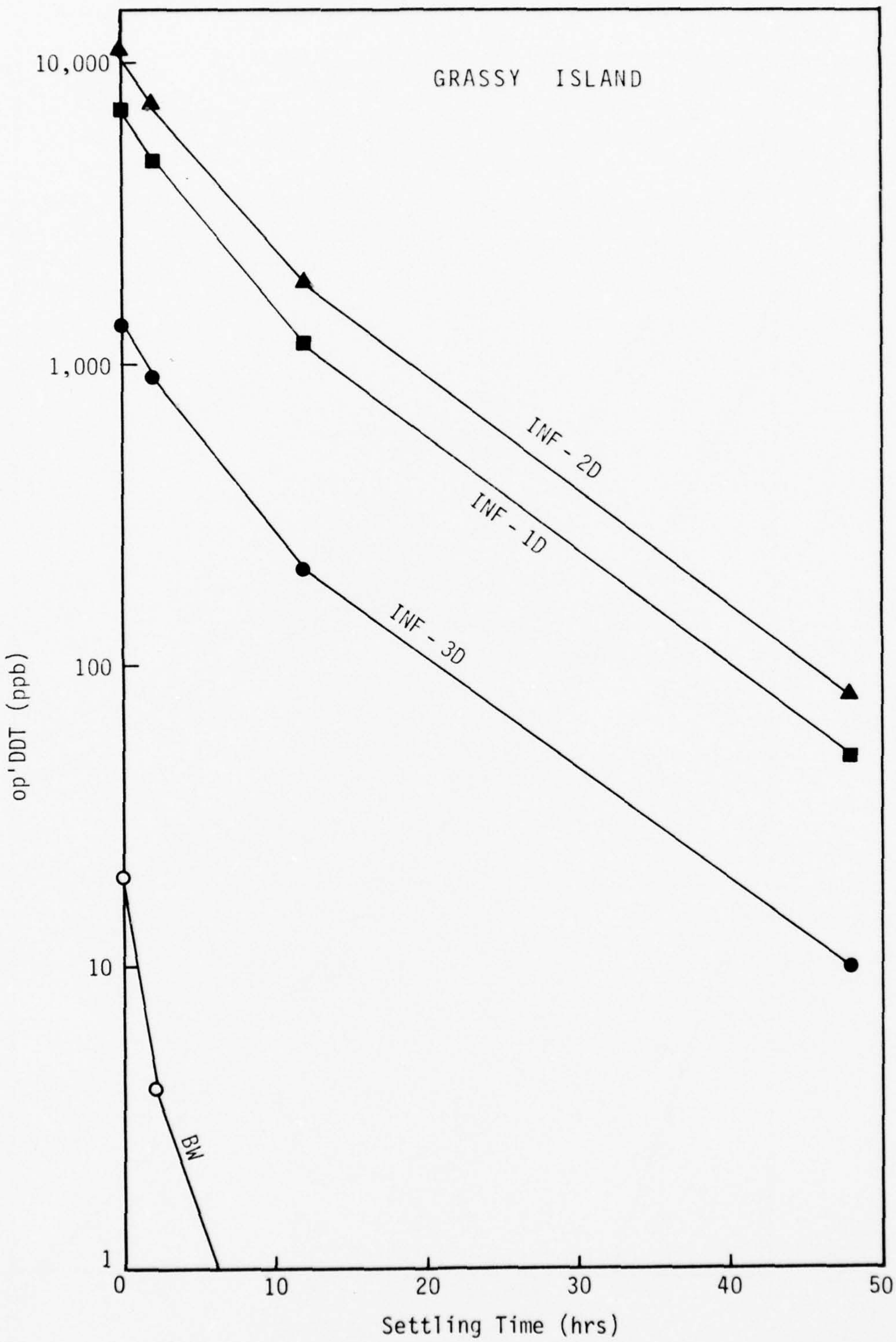

Figure 23. Supernatant Concentration of op'DDT vs. Settling Time.

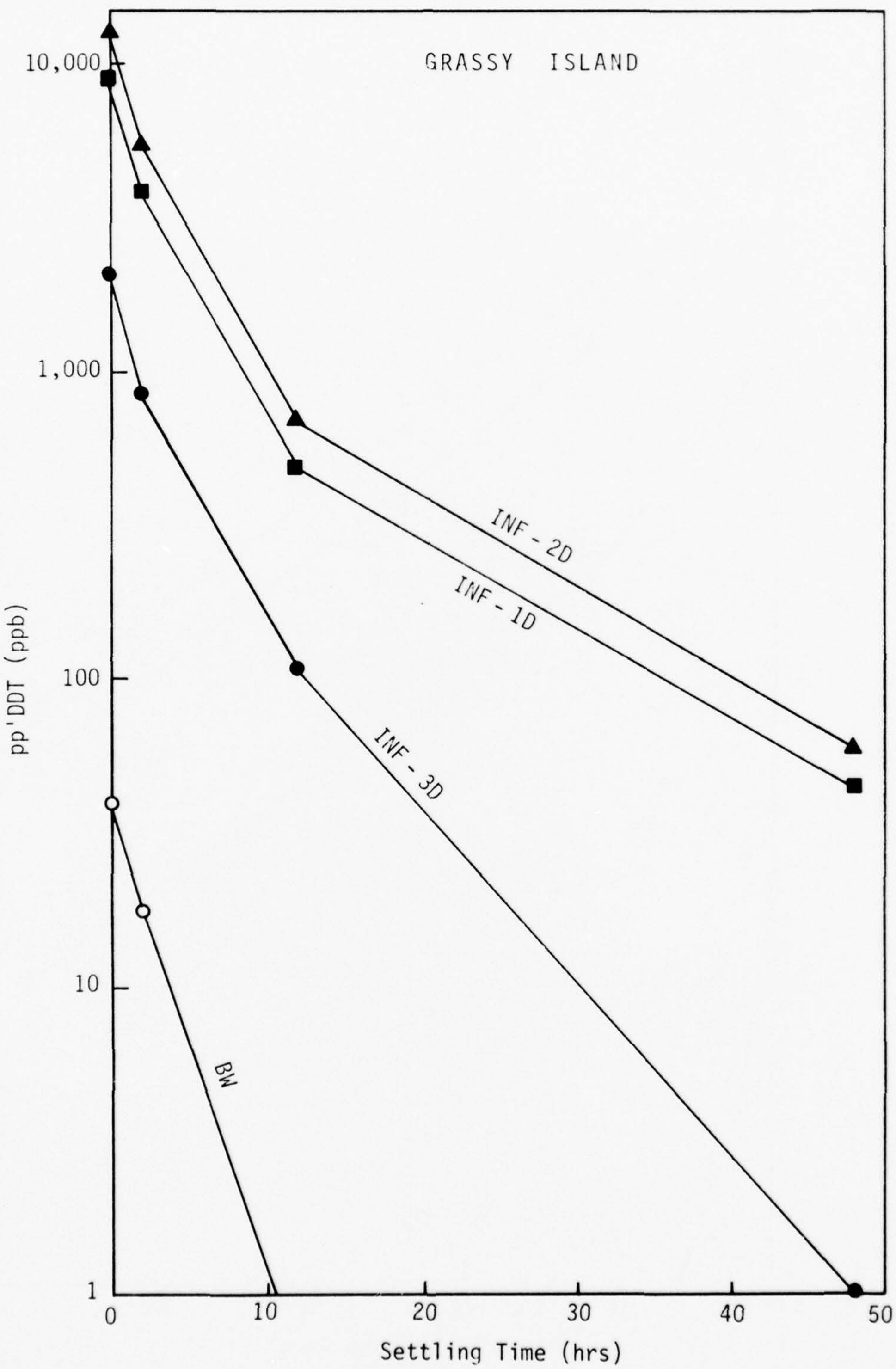

Figure 24. Supernatant Concentration of pp'DDT vs. Settling Time.

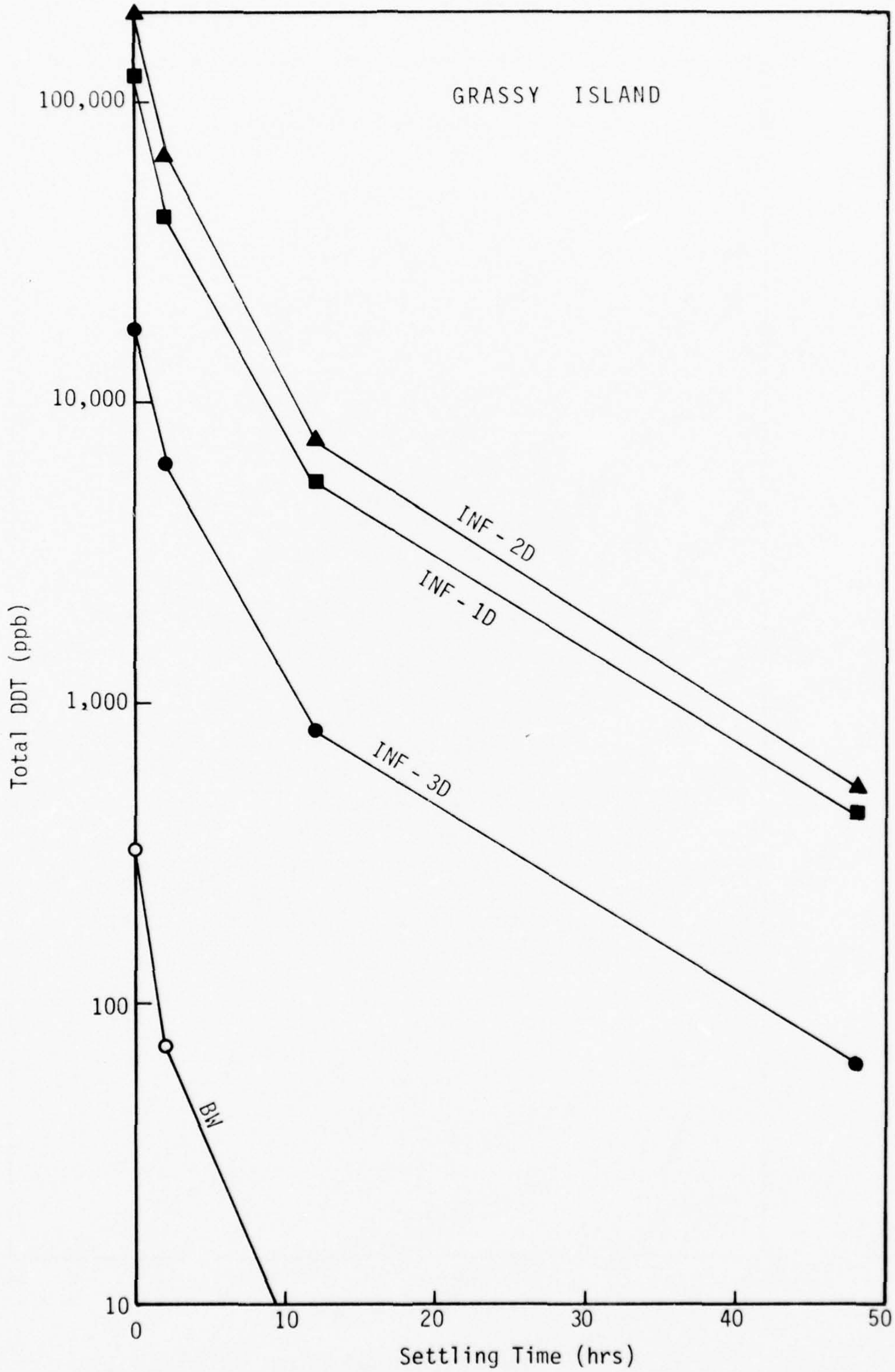

Figure 25. Supernatant Concentration of Total DDT vs. Settling Time.

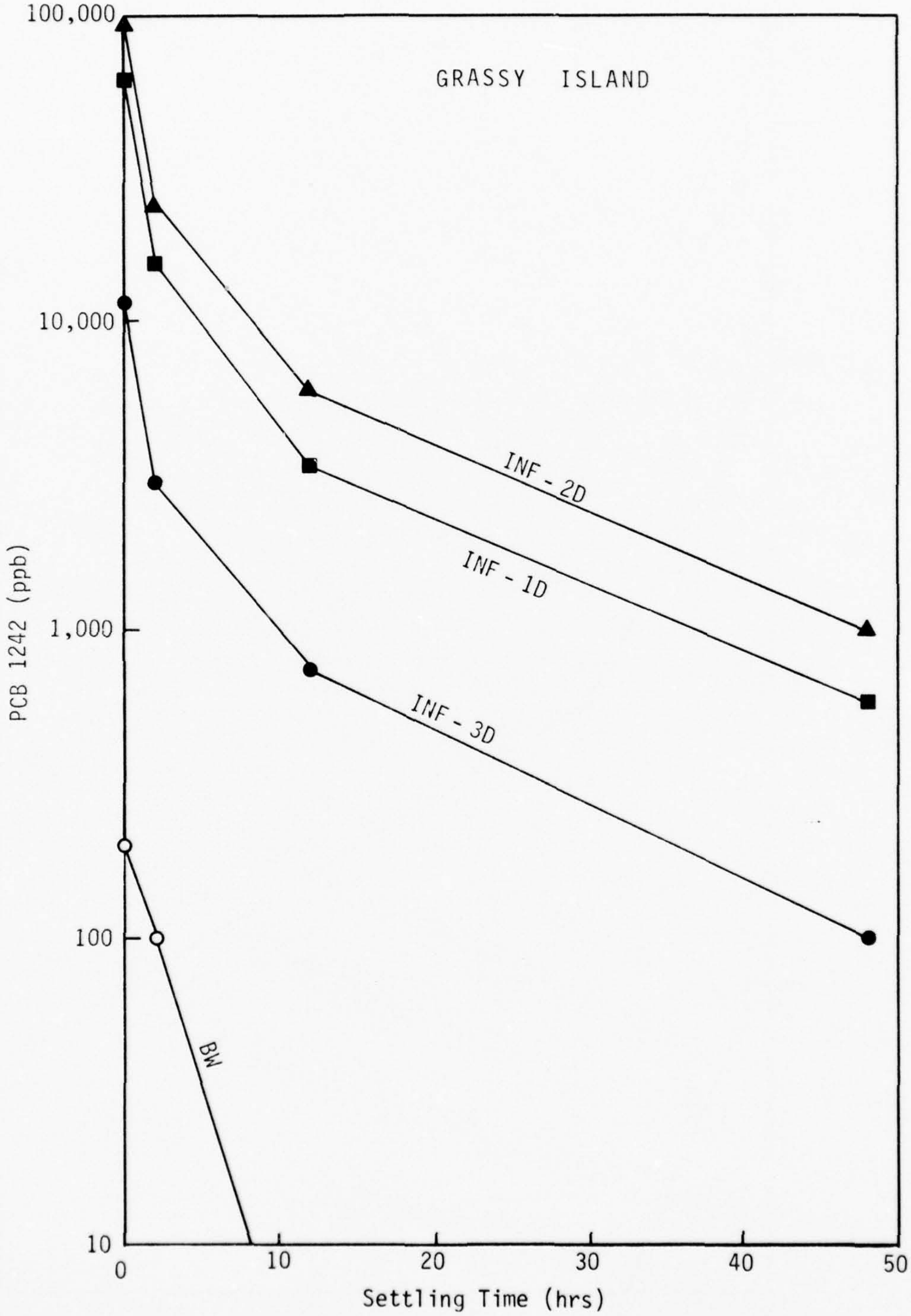

Figure 26. Supernatant Concentration of PCB 1242 vs. Settling Time.

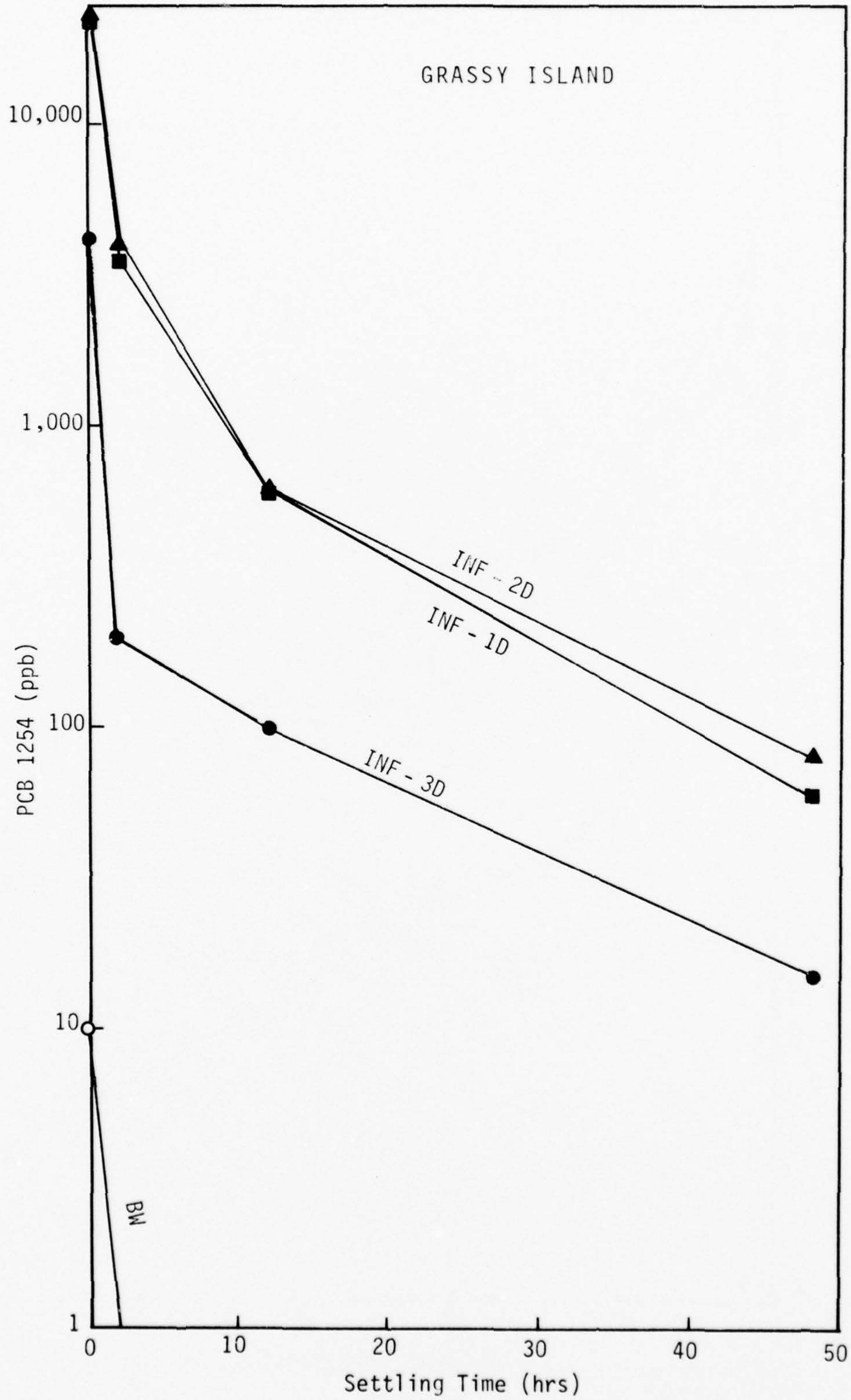

Figure 27. Supernatant Concentration of PCB 1254 vs. Settling Time.

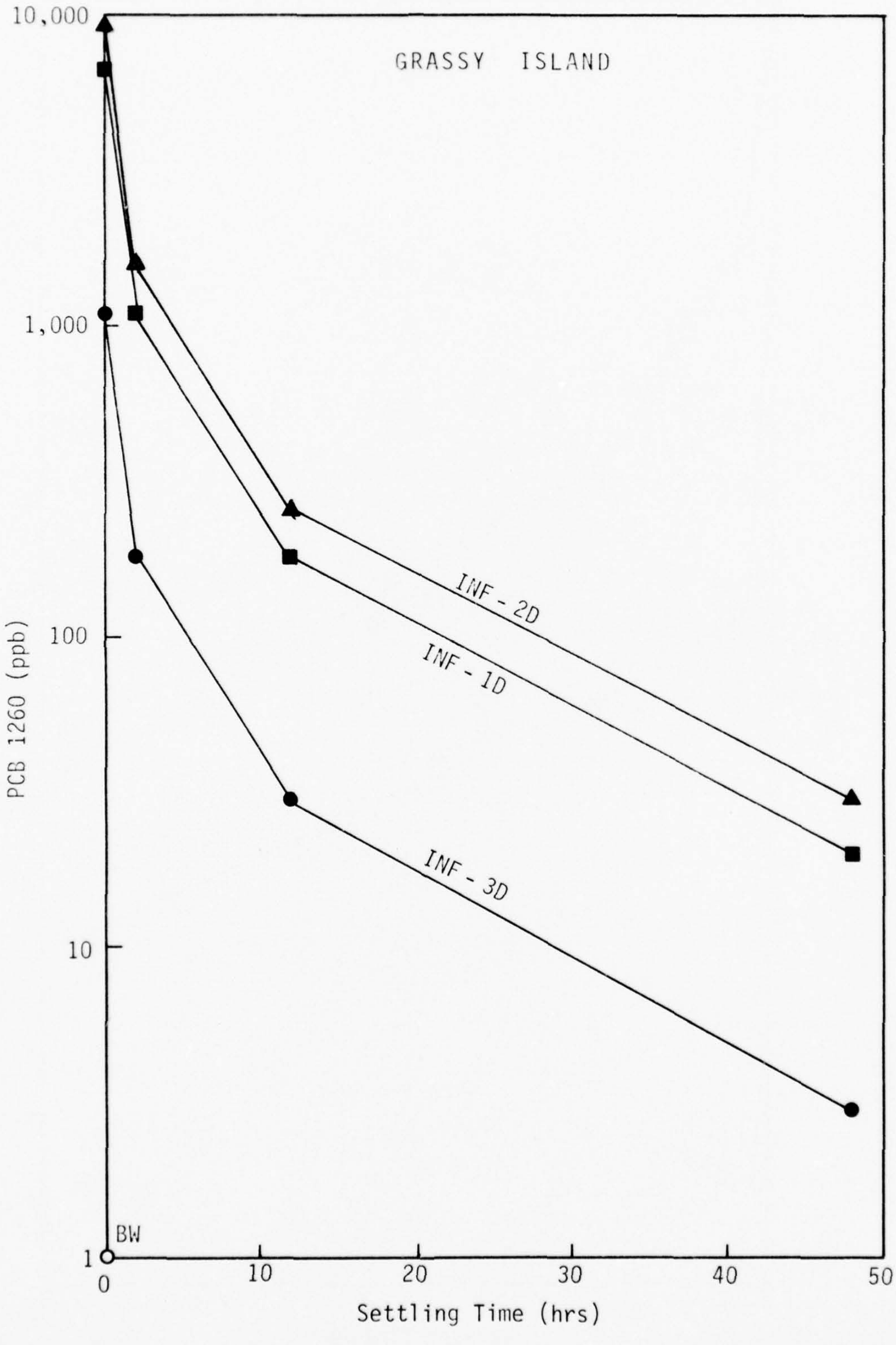

Figure 28. Supernatant Concentration of PCB 1260 vs. Settling Time.

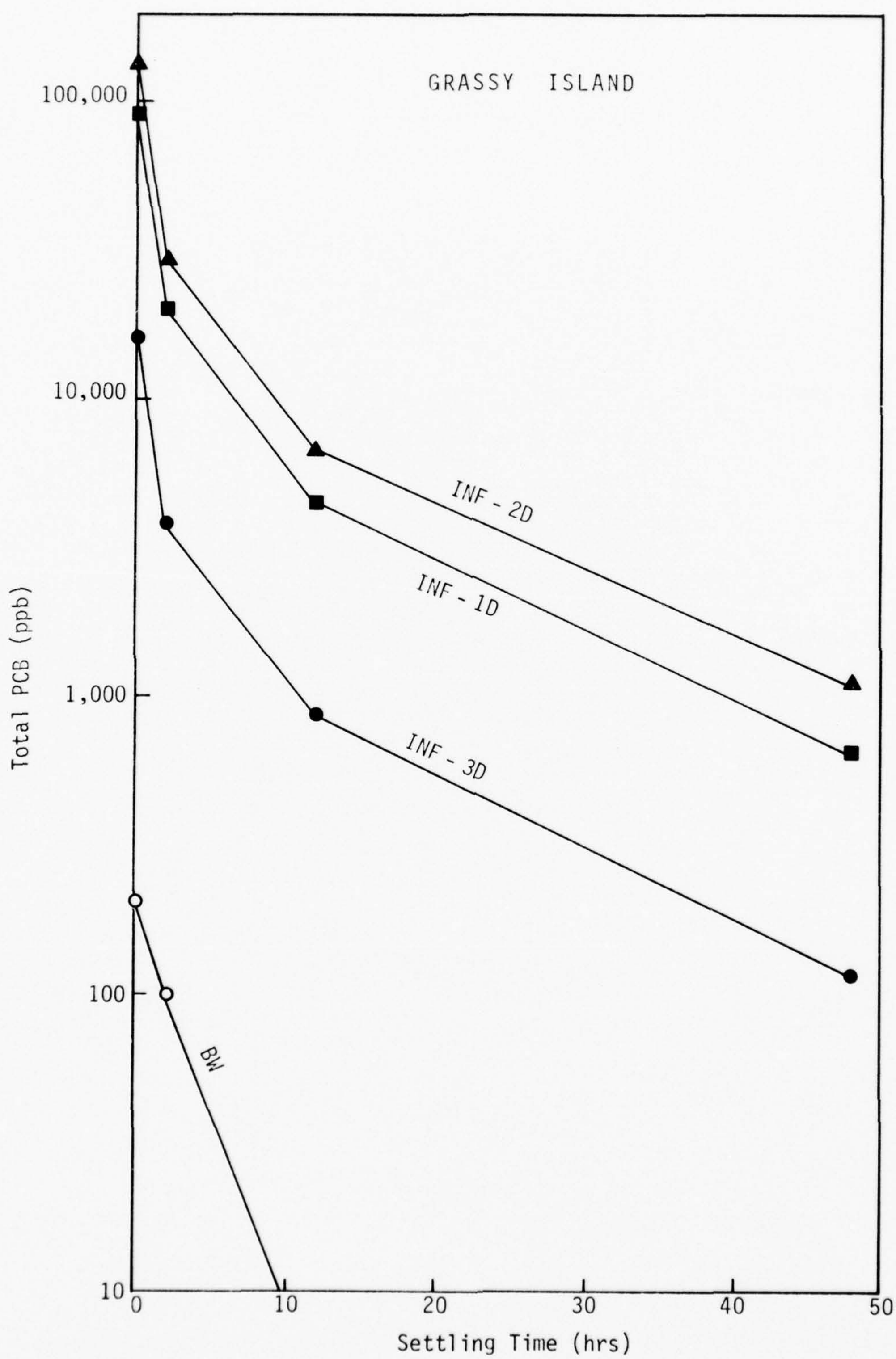

Figure 29. Supernatant Concentration of Total PCB vs. Settling Time.

APPENDIX A: VEGETATIVE LISTING
PINTO ISLAND, MOBILE BAY ALABAMA

1. Echinochloa walteri (Pursh) Heller
2. Scirpus maritimums L.
3. Sesbania drummondii (Rydb.) Cory.
4. Panicum repens L.
5. Rumex chrysocarpus Moris.
6. Paspalum vaginatum Sw.
7. Distichlis spicata (L.) Greene
8. Cyperus strigosus L.
9. Sabatia capestria Nutt.
10. Sebania vesicaria (Jacq.) Ell.
11. Myrica cerifera L.
12. Heliotropium curassavicum L.
13. Heterotheca subaxillairs (Lam.) Britt. & Rusby
14. Crotalaria spectabilis Roth.
15. Kosteletzkya virginica (L.) Gray
16. Hypericum gentianoides (L.) B.S.P.
17. Andropogon spp.
18. Diodia teres Walt.
19. Fimbristylis castanea (Michx.) Vahl.
20. Erechites hieracifolia (L.) Raf.
21. Baccharis halimifolia L.
22. Verbena brasiliensis Vell.
23. Cyperus compressus L.
24. Strophostyles helvola (L.) Ell.
25. Xanthocephalium dracunculoides (DC.) Shinners
26. Salincornia bigelovii Torr.
27. Sapium sebiferum (L.) Roxb.
28. Cinnamomum camphora (L.) Nees and Eberm.
29. Eragrostis oxylepis (Torr.) Torr.
30. Phytolacca americana L.
31. Solanum sisymbriifolium lam.

32. Aster subulatus Michx. (A. exilis of some suth.)
33. Typha angustifolia L.
34. Paspalum urvillei Steud.
35. Panicum dichotomiflorum Michx.
36. Eupatorium serotinum Michx.
37. Solidago sempervirens L.
38. Eupatorium capillifolium (Lam.) Small
39. Helenium amarum (Raf.) Rock.
40. Salix nigra L.
41. Pluchea purpurascens (Sw.) DC.
42. Cynodon dactylon (L.) Pers.
43. Mollugo verticillata L.
44. Chenopodium ambrosioides L.
45. Leptochloa fascicularis (Lam.) A. Gray
46. Panicum spp.
47. Juncus spp.
48. Crotalaria spp.

General Notes

1. Barren areas appear to approach the 14' elevation where vegetation then begins. Annual herbs appear from approximately 15 to 19 feet elevation, shrubs and perennial herbs from 19 to 22 feet elevation.

2. Dominant herbs at lower elevations are Pluchea purpurascens, Aster subulatus and Panicum dichotomiflorum. At higher elevations Panicum rapens, Solidago sempervirens, Andropogon spp. and Strophostyles helvola are very common. Shrubs (Baccharis halimifolia and Myrica certifera) and trees (Salix nigra) occur at the highest elevations along with Phragmites communis.

3. Pools of saline water occur at the lowest elevations. A gull rookery exists on barren dry land areas between dredging periods.

APPENDIX B: ANALYTICAL METHODS

Metals

Total sample

1. Total sample for the determination of metals (except Hg) was digested by concentrated HF, HNO_3 and $HClO_3$ at 175^oF in a Teflon beaker (with Teflon cover) until the solution cleared. Atomic absorption spectrophotometers (Perkin-Elmer Models 305B and 460) were used for the analysis of metals. Both flame and heated graphite atomizers (HGA 2100) were used for total sample analysis. The choice of an atomizer is dependent on the suitable linear range of the element. The following table is a guide for choosing the atomizer:

	Optimum Working Range	
	Flame Atomizer (mg/1)	Heated Graphite Atomizer (pg)*
Na	0.03 - 1	20 - 2000
K	0.1 - 2	10 - 2500
Ca	0.2 - 20	20 - 1000
Mg	0.02 - 2	1 - 40
As	0.002 - 0.02	50 - 1000
Cd	0.05 - 2	3 - 100
Cu	0.2 - 10	50 - 2000
Fe	0.3 - 10	30 - 1000
Hg	10 - 300	500 - 7000
Mn	0.1 - 10	10 - 500
Ni	0.3 - 10	200 - 5000
Pb	1 - 20	50 - 1500
Se	0.002 - 0.02	50 - 1000
Ti	5 - 100	1000 - 80000
V	2 - 100	400 - 20000
Zn	0.05 - 2	1 - 70

* based on interrupt flow of argon gas

2. Samples for total mercury analysis were digested in Teflon bombs (Parr no. 4745). The procedures are as follows:

   a. Weigh in triplicate 0.1-1 g of sample and and place in bottom of a Teflon acid digestion bomb.

b. Carefully add 10-ml conc. HNO_3, 3 ml 48% HF and close the digestion bomb tightly.

c. Place the digestion bomb into an oven (or hot plate) and adjust the temperature to 70°C.

d. Digest the sample until solution is clear.

Filtrate sample

3. Analyses of trace metal in filtrates (except Hg) were performed by flameless atomic absorption spectrophotometry. A Perkin-Elmer HGA 2100 was used. If the concentration of trace metals was below the detection limit of the graphite furnace atomizer, then the APDC-MIBK extraction method was used[11].

4. The cold vapor atomic absorption method was used for Hg determination. Major cations in the filtrate sample (Ca, Mg, K, and Na) were analyzed by flame atomic absorption spectrophotometry.

Hexane extracts (oil and grease sample)

5. The analysis of trace metals in hexane extracts was performed by direct injection of extracts in a heated graphite atomizer. Mercury analysis was not performed due to insufficient sample. Samples for major ions were prepared by drying the hexane extracts and redissolving into HNO_3 ($pH \leq 1$).

Phosphorus

6. Total phosphorus was measured using the modified ascorbic acid method. The procedures are described as follows:

a. Measure 1 - 5 ml of slurry sample and put in Teflon beaker (if filtrate sample, use 50-100 ml).

b. Digest the sample at water boiling temperature using HF (1 ml) and $HClO_4$ (2 ml) with Teflon cover.

c. After solution is clear, remove the cover and

heat to dryness.

d. Cool, add 2 ml of H_2O_2 and heat to dryness again.

e. Add 20 ml of H_2O and 5 ml of 10N H_2SO_4.

f. Filter the sample through a glass fiber filter and dilute to 100 ml.

g. Take 40 ml of sample and add 3 ml of 1.6% ammonium molybdate and 4 ml of mixed reagent. (Mixed reagent = 50 ml of tartrate + 50 ml of 10% ascorbic acid.) (If dilution is required, the reagents to sample ratio should be kept constant. An appropriate amount of 10N H_2SO_4 should be used to keep the final pH value constant.)

h. Measure the sample by spectrophotometer at 717 nm.

7. The measurement of orthophosphate in filtrates was performed as above without the digestion procedures.

Acid Soluble Sulfide

8. Total acid soluble sulfide was determined by stripping and titrimetric processes.

a. Measure 5 ml ZnAc and 95 ml distilled water into absorption flasks. Connect the two adsorption flasks with a 1-liter reaction flask and purge the system with N_2 gas for 5 minutes.

b. Transfer 10-to-50-ml slurry sample into the reaction flask and add distilled water to 500 ml, then mix completely.

c. Acidify the sample with 10 ml conc. H_2SO_4 and replace the prepared 2-hole stopper tightly. Pass N_2 through sample for approximately one hour.

d. Add 10 ml of iodine solution and 2.5 ml conc. HCl to each of the absorption flasks, shake and mix thoroughly.

e. Transfer contents of both flasks to a 500-ml flask and back-titrate with 0.025N sodium thiosulfate titrant, using starch solution as indicator.

Chlorinated Hydrocarbons

9. The extraction, separation, and identification of chlorinated hydrocarbons were performed in accordance with the published literature [12-19]. The details of the operation are described as follows.

Extraction

10. 500-ml slurry sample (300-ml supernatant sample) was weighed into a 500-ml Erlenmeyer flask with ground glass stopper. To this flask was added 250 ml of acetonitrile (pesticide quality, Mallinkrodtt). The flask was then shaken for 1 hr on a reciprocal shaker. The sample was kept in a constant temperature chamber ($14 \pm 2^{o}C$) overnight. Next, the sample was again shaken for 2 hrs and filtered through 5 g of Celite (Celite 545, Sargent Welch) media on Whatman No. 4 filter paper under mild vacuum. At this time another 100-ml of acetonitrile was added to avoid the possible loss of chlorinated hydrocarbons on the flask wall, Celite, or residue. The filtrate was transferred to a 500-ml Kuderna-Danish concentrator and concentrated to 5 ml in a water bath. The concentrated extract (filtrate) was then transferred to a 1000-ml separatory funnel containing 200 ml of double-distilled water and 10 ml of saturated aqueous NaCl. Eighty ml of petroleum ether (pesticide quality) was used to clean the concentrator, and was then added to the separatory funnel. The funnel was shaken by hand for 5 min and then kept still until clear separation of phases occurred. The aqueous phase (bottom layer) was drained into another separatory funnel containing 80 ml of petroleum ether for the second extraction. After the third extraction, the aqueous phase was discarded and all petroleum ether extracts were collected into a Kuderna-Danish concentrator. After the petroleum ether extract was concentrated to approximately 5 ml, it was then eluted on the prepared acti-

tivated florisil column.

Florisil column elution

11. A chromatographic tube (450 x 28 mm) with a removable frittered glass and Teflon stopcock was packed with 15 g of activated florisil (60/100 mesh, G.C. grade) and topped with 15 g of anhydrous sodium sulfate (analytical grade, Mallinkrodtt). The column was then washed with 70 ml of petroleum ether. The petroleum ether extract (concentrated) was added when the petroleum ether wash sank through the top surface of the anhydrous sodium sulfate. Elution was then carried out, first with 175 ml of petroleum ether (0% E.E. = 0%v ethyl ether + 100%v petroleum ether; 6% E.E. = 6%v ethyl ether + 94%v petroleum ether; and 15%v E.E. = 15%v ether + 85%v petroleum ether); next with 100 ml of 6% E.E.; and finally, with 150 ml of 15% E.E. During elution, flow rate was controlled by the stopcock at approximately 2 ml/min. With this florisil column elution, PCB's and most of the DDE were recovered in 0% E.E.; most organochlorine compounds in 6% E.E.; endrin and dieldrin in 15% E.E. The eluted sample was again concentrated and the exact volume was measured.

Identification and quantification

12. Standard solutions of chlorinated hydrocarbons used in this study are more than 99% pure. The DDT series were obtained from Supelco, PCB's from Monsanto, and dieldrin from Shell Chemical. A Hewlett-Packard Research Gas Chromatograph Model 5750 equipped with a Ni^{63} electron capture detector was used throughout the study. The glass column (1220 x 4 mm) was packed with 5% QF-1 (Chromosorb W-HP, 80/100 mesh, Sargent-Welsh). The carrier gas was 95% argon and 5% methane.

13. The sample components were identified by comparison of retention times of unknown peaks to the known peaks of reference standard solutions, and were quantified by comparison of the peak height of the identified component to

the peaks of the component in the reference standard solution.

14. Preliminary sample injections were always performed to decide whether further concentration or dilution of the sample would be required, and to judge which series of reference standard solutions should be used.

15. Chlorinated hydrocarbons in the oil and grease fraction were analyzed by the same method as mentioned above. However, the acetronitrile extractant was omitted and the petroleum ether was directly used for the extraction.

Hydrocarbons

16. The following methods and comments pertain to GC-MS mass fragment graphic analysis of hydrocarbons in dredged material slurry and water samples. A high resolution glass capillary column was used to separate the sample components and mass fragment graphic analysis was also performed for hydrocarbon samples.

Reagents

Silica gel 923	Davison
Methylene Chloride	distilled-in-glass
Hexane	distilled-in-glass
Na_2SO_4	ACS, grade or better, with either Alundum boiling chips, broken in 1-mm fragments.

Gas Chromatography

17. All gas chromatography was performed in a Finnigan 9500 GC which is part of a Finnigan 1015D GC-MS system. The extracts were separated in a 30-meter x 0.25-mm glass capillary column coated with SE-30. The column was temperature-programmed from 100^{o} to 220^{o}C at 2^{o}/min with no initial isothermal hold. The final hold was variable since no timer was available to control the parameter.

18. In some cases the temperatures were isothermal to permit rapid repetitive analysis of compound, e.g., naphthalene. The temperature for phenanthrene was 180°C while the temperature for naphthalene was 100°C. The split ratio for the column was 10 to 1. The column inlet pressure was 21 pound/in^2. The dead volume of the column was 2 min for helium carrier gas.

Mass spectrometer parameters

Emission current	450 pump μamp
Preamp range	10^{-8} amp/volt
Mass coil	10-250 range
Electron multiplier voltage	1.9 kV
Electron energy	70 eV

Programmable multiple-ion monitor settings

alkanes	m/e 99 & m/e 85
naphthalene	m/e 128
phenanthrene	m/e 178
other aromatics	m/e 162, 156, 142

Quantification with PROMIN

19. The Finnigan PROMIN combined with the 1015D gives an inherently linear response in the concentration range under consideration. Quantification is therefore determined by the peak height ratio between standard and sample. For example, if a 4-μg naphthalene standard gives a peak height of 30 divisions and the sample has a peak of 25 divisions, then the sample has $\frac{25}{30}$ x 4-μg, or 3.33-μg of naphthalene.

20. Total alkane is calculated by summing all of the peak heights of the alkane peaks. A factor of 20-μg per 12 divisions was used to calculate the total amount of alkane. This factor is an average value. A more precise way to perform this calculation is to prepare a mixed standard containing all hydrocarbons observed in the sample and use a computer to integrate peak areas and calculate concentrations. It should be pointed out, however, that without

GC resolution of all hydrocarbons, the computer programs cannot accurately quantify fused peaks.

Computer parameters

21. A Systems Industries System 150 data system was used as adjunct to the PROMIN, particularly for the aromatics. The data system acquired the data in the scan mode. Ions specific for naphthalene, methylnaphthalenes, dimethylnaphthalenes, and phenanthrene were used to construct mass chromatograms. These mass chromatograms were examined with respect to ion current (GC peaks) at retention times appropriate for the specified organics. The GC peaks were integrated by the computer and the peak area compared to mass chromatograms generated from standards.

Scan parameters

Mass range:	100 to 255
Integration time:	20 milliseconds
Sample:	1
Threshold:	1
Total run time:	50 min.

Preparation of silica gel column

a. Heat Davison 923 silica gel for 2 hr at 180 ^{o}C. Deactivate by shaking 2 hr with 3 ml water per 100 g of silica gel. Allow to stand overnight in tightly sealed glass container.

b. Prepare column as shown in diagram (Figure B1).

Sample extraction

22. Sediment samples

a. Weight sediment sample into mortar and grind with 5x sample weight of 3% deactivated silica gel 923.

b. Place mixture into Randall fat extractor thimble and lower thimble into boiling methanol.

c. Reflux for two hours.

d. Raise thimble out of methanol into the condensate stream to rinse and complete extrac-

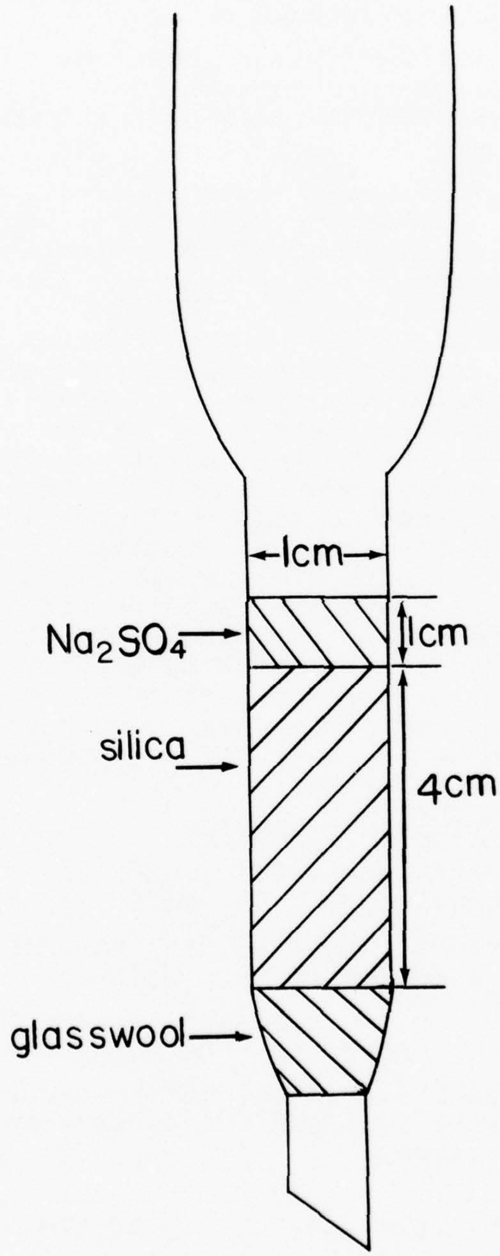

Figure B1. Silica Gel Column.

tion for 2 additional hours.

e. Concentrate the methanol to about 20 ml then dilute to 250 ml with water (methylene chloride-washed) and extract 3 times with 25 ml of methylene chloride.

f. Add the methylene chloride to a Kuderna-Danish concentrator along with 30 ml hexane (redistilled in glass) and concentrate to 5 ml.

g. Transfer the hexane concentrate to the 4-cm x 1-cm silica 923 column. Wash the concentrator with 5 ml of hexane and add the hexane to the column. Wash the alkanes through the column with 25 ml hexane. Collect and concentrate the hexane fraction to 5 ml in a Kuderna-Danish concentrator. Transfer the concentrate to a rigorously-cleaned 5-ml screw-cap test tube. Allow the liquid to concentrate to 1 ml at ambient temperature. Loosely cover the test tubes with aluminum foil during this process. After the volume has reached 1 ml, tightly seal the test tubes with a clean, foil-lined screw cap. This test tube contains the alkanes. Wash the column with 25 ml of ethyl ether. Collect and concentrate to 5 ml in the K-D concentrator. Add 1 ml of hexane and transfer to a screw-cap test tube. Allow to concentrate as above. This fraction contains the aromatics.

23. Water slurry or samples

a. Decant the water into a clean separatory funnel. Hold for later steps.

b. Transfer the sediment portion into a Randall extraction thimble with methanol washes.

c. Reflux the sediment as described previously and concentrate the methanol to ∿20 ml.

d. Add the methanol to the separatory funnel (step two) and concentrate as previously described.

Sensitivity

24. The absolute sensitivity of the capillary column GC-MS system for a particular compound depends upon split ratio, electron multiplier voltage, mass coil, MS resolution, and the structure of the individual compound. This

sensitivity will vary from day to day because of the aggrate small changes in several of the above parameters. The sensitivities for individual compounds given below are conservative and may not reflect the very best obtainable.

naphthalene:	0.5 μg
phenanthrene:	0.5 μg
an individual alkane:	1 μg

25. The detection limit for a specific alkane does not necessarily reflect the detection limit of total alkanes. In order to determine total alkanes, the chromatograph must be spread across 10 GC peaks, in which case, an alkane with as low a concentration as 0.1 μg/gm might be detected. The detection limit takes into account both sample size and sensitivity of instrumentation

APPENDIX C: ANALYTICAL LABORATORY DATA

TABLE C1

PINTO ISLAND: GENERAL PARAMETERS OF INFLUENTS, EFFLUENTS, AND BACKGROUND WATER

Sample ID		pH*	Salinity* o/oo	Conductivity* mMhos	Dry Weight %	Total* Alkalinity mg/l as $CaCO_3$	Chloride* mg/l	Cation Exchange Capacity meq/l	Total Acid Soluble Sulfide mg/l
Background Water	BW-B	7.6	3	5.9	0.42	50	1.90	-	trace
	BW-C	7.5	3	4.0	0.50	50	1.90	-	trace
Influent	INF-1B	8.0	27	22.54	7.54	192	15.2	3.6	18.1
	INF-1C	7.8	28	25.62	4.80	202	15.2	18.1	-
	INF-2B	7.1	24	25.19	5.37	174	12.2	43.5	15.1
	INF-2C	7.1	24	25.19	8.76	174	12.2	58.7	27.9
	INF-3B	7.2	26	24.74	11.1	82	13.0	29.7	19.9
	INF-3C	7.1	24	25.85	4.80	80	13.3	16.7	17.1
Effluent	EFF-1B	7.6	18	19.80	3.72	262	10.3	18.1	4.2
	EFF-1C	8.1	18	18.01	3.63	254	10.3	21.7	3.8
	EFF-1D	7.9	18	18.40	3.42	234	10.6	6.5	5.9
	EFF-1E	7.4	22	21.20	3.09	180	10.1	4.3	2.1
	EFF-2B	7.7	22	21.47	3.44	230	12.8	4.4	2.2
	EFF-2C	8.2	18	18.70	3.54	188	12.2	5.3	1.5
	EFF-2D	8.2	21	25.31	4.14	270	10.1	19.6	2.2
	EFF-2E	7.9	22	23.34	3.61	190	12.2	4.4	3.3
	EFF-3B	7.5	22	25.42	3.89	136	13.0	11.6	5.0
	EFF-3C	-	-	-	-	-	-	(8.0)	-
	EFF-3D	7.5	23	24.60	5.32	200	13.3	12.8	3.4
	EFF-3E	8.2	22	25.88	4.33	200	13.0	24.6	2.7

* Analyses were performed on 0.45-μ filtrate.

\- Not determined (indicates insufficient sample or sample destroyed in transit).

TABLE C2

GRASSY ISLAND: GENERAL PARAMETERS OF INFLUENTS, EFFLUENTS AND BACKGROUND WATER

Sample ID		pH*	Salinity* o/oo	Conductivity* mMhos	Dry Weight %	Total* Alkalinity mg/l as $CaCO_3$	Chloride* mg/l	Cation Exchange Capacity meq/l	Total Acid Soluble Sulfide mg/l
Background Water	BW A	7.3	trace	0.04	(0.01)∫	130	26.8	-	trace
Influent	INF-1B	8.4	trace	0.125	17.8	470	40.7	37.7	31.2
	INF-1C	8.0	trace	0.114	16.6	310	46.1	36.2	38.0
	INF-2B	8.4	trace	0.125	18.9	610	67.8	161.6	39.9
	INF-2C	8.4	trace	0.125	20.6	600	67.8	60.9	48.9
	INF-3B	8.3	trace	0.080	24.0	520	40.7	81.2	38.1
	INF-3C	8.3	trace	0.080	13.9	520	40.7	38.0	34.0
Effluent	EFF-1B	8.4	trace	0.068	(0.04)	250	53.9	-	0.2
	EFF-1C	8.2	trace	0.057	(0.03)	220	44.9	-	trace
	EFF-2B	8.3	trace	0.057	(0.10)	198	46.1	-	0.3
	EFF-2C	8.6	trace	0.068	(0.04)	286	46.1	-	trace
	EFF-3B	8.1	trace	0.080	(0.05)	220	48.8	-	trace
	EFF-3C	8.0	trace	0.068	(0.10)	290	-	-	0.4

* Analyses were performed on a 0.45-μ filtrate.

\- Not determined (indicates insufficient sample or sample destroyed in transit).

∫ Due to the insufficient amount of the solids, values in ( ) are for reference only.

TABLE C3

PINTO ISLAND: CONCENTRATION OF TOTAL CARBON, TOTAL ORGANIC CARBON AND OIL AND GREASE IN INFLUENT, EFFLUENT, AND BACKGROUND WATER SAMPLES

Sample ID		TOTAL CARBON				TOTAL ORGANIC CARBON				OIL AND GREASE				
		Total* mg/l	8-μ Filtrate mg/l	0.45-μ Filtrate mg/l	0.05-μ Filtrate mg/l	Total* mg/l	8-μ Filtrate mg/l	0.45-μ Filtrate mg/l	0.05-μ Filtrate mg/l	Total* mg/l	2 hrs. Settling mg/l	12 hrs. Settling mg/l	24 hrs. Settling mg/l	48 hrs. Settling mg/l
Background Water	BW-B	20.0	13.8	11.3	12.5	10.0	5.0	3.8	3.0	4	6ʃ	trace	trace	trace
	BW-C	16.3	14.0	11.3	12.0	4.4	4.0	2.5	3.2	3				
Influent	INF-1B	61.5	52.5	49.0	47.5	22.4	10.0	11.5	10.5	684	124ʃ	141	401	123
	INF-1C	56.3	49.0	47.5	48.0	12.7	9.3	7.5	8.2	465				
	INF-2B	-	-	-	-	32.5	13.6	14.2	13.0	287	34ʃ	30	36	33
	INF-2C	93.8	49.5	47.6	47.0	31.3	14.5	14.5	12.5	301				
	INF-3B	45.0	25.0	25.0	26.5	10.0	7.5	7.0	7.8	488	14ʃ	16	28	35
	INF-3C	40.0	23.0	23.2	23.0	7.5	7.0	7.0	6.5	511				
Effluent	EFF-1B	80.0	65.5	68.8	57.6	10.0	6.5	5.0	5.2	23				
	EFF-1C	80.0	65.0	65.0	65.0	10.0	7.5	7.5	7.5	16	4ʃ	6	12	23
	EFF-1D	58.8	57.5	57.5	56.3	8.5	2.5	2.5	6.3	16				
	EFF-1E	62.5	47.8	46.0	41.3	7.5	6.2	6.2	5.3	57				
	EFF-2B	58.8	53.8	53.8	53.8	13.8	4.5	4.5	6.3	28				
	EFF-2C	85.0	57.5	52.5	49.0	33.8	9.5	8.5	4.5	62	2ʃ	14	16	26
	EFF-2D	342	76.3	75.0	72.5	264	16.3	12.5	12.5	22				
	EFF-2E	59.6	49.2	47.3	42.5	7.1	5.5	3.5	4.8	50				
	EFF-3B	58.8	45.0	40.0	39.0	22.5	11.3	5.0	5.3	57				
	EFF-3C	-	-	-	-	-	-	-	-	-				
	EFF-3D	52.5	50.5	49.2	48.6	26.5	11.5	9.7	9.4	105	5ʃ	39	53	66
	EFF-3E	-	59.6	52.5	52.5	-	12.1	5.0	7.5	63				

* Samples were shaken and then allowed to settle. The supernatant was withdrawn with a Hamilton Syringe (406-μ opening) and injected into the TOC Analyzer.
\- Not determined (indicates insufficient sample or sample destroyed in transit).
ʃ Composite sample.

TABLE C4

GRASSY ISLAND: CONCENTRATION OF TOTAL CARBON, TOTAL ORGANIC CARBON AND OIL AND GREASE IN INFLUENT, EFFLUENT, AND BACKGROUND WATER SAMPLES

Sample ID		TOTAL CARBON				TOTAL ORGANIC CARBON				OIL AND GREASE				
		Total* mg/l	8-μ Filtrate mg/l	0.45-μ Filtrate mg/l	0.05-μ Filtrate mg/l	Total* mg/l	8-μ Filtrate mg/l	0.45-μ Filtrate mg/l	0.05-μ Filtrate mg/l	Total* mg/l	2 hrs. Settling mg/l	12 hrs. Settling mg/l	24 hrs. Settling mg/l	48 hrs. Settling mg/l
Background Water	BW A	38	29.5	30	28	12	5.2	3.5	3.0	32	8	trace	12	-
Influent	INF-1B	178	147	135	106	35	15	15	11	3082 }	-	$303^{\int}$	1010	304
	INF-1C	155	135	135	110	52	16	13	5	3600				
	INF-2B	276	248	224	170	86	64	53	47	5430 }	-	$1570^{\int}$	2300	681
	INF-2C	209	165	163	142	71	19	21	16	4900				
	INF-3B	249	170	144	130	68	32	25	22	8420 }	-	$581^{\int}$	1400	32
	INF-3C	216	133	124	120	65	13	15	13	6150				
Effluent	EFF-1B	101	64	59	-	24	34	4	-	11 }	$5^{\int}$	14	17	17
	EFF-1C	98	60	59	54	21	27	26	29	28				
	EFF-2B	98	63	64	65	23	5	2	10	13 }	$3^{\int}$	4	8	13
	EFF-2C	96	64	54	53	29	13	12	9	-				
	EFF-3B	101	76	75	52	26	21	8	8	- }	$2^{\int}$	6	6	6
	EFF-3C	85	81	73	70	19	20	15	12	8				

* Samples were shaken and then allowed to settle. The supernatant was immediately withdrawn with a Hamilton Syringe (406-μ opening) and injected into the TOC Analyzer.

\- Not determined (indicates insufficient sample or sample destroyed in transit).

$\int$ Composite sample.

TABLE C5

PINTO ISLAND: CONCENTRATION OF NITROGEN AND PHOSPHORUS SPECIES IN INFLUENT, EFFLUENT, AND BACKGROUND WATER SAMPLES

Sample ID		NH_3-N				ORGANIC N			
		Total mg/l	8-μ Filtrate mg/l	0.45-μ Filtrate mg/l	0.05-μ Filtrate mg/l	Total mg/l	8-μ Filtrate mg/l	0-45-μ Filtrate mg/l	0.05-μ Filtrate mg/l
Background Water	BW-A	trace	trace	trace	trace	0.91	0.64	0.34	0.24
Influent	INF-1A	22.3	13.1	12.6	9.40	17.5	6.22	6.10	6.10
	INF-2A	6.38	1.43	1.27	-	31.9	9.17	13.5	12.0
	INF-3A	1.90	0.78	0.64	-	43.8	7.02	6.74	-
Effluent	EFF-1A	8.93	3.29	3.19	1.81	8.20	7.44	6.10	5.50
	EFF-2A	-	-	-	-	-	-	-	-
	EFF-3A	17.5	0.96	0.80	0.61	16.7	7.49	8.05	-

Sample ID		TOTAL P				NO_3-N	NO_2-N
		Total mg/l	8-μ Filtrate mg/l	0.45-μ Filtrate mg/l	0.05-μ Filtrate mg/l	0.45-μ Filtrate mg/l	0.45-μ Filtrate mg/l
Background Water	BW-A	0.19	trace	trace	trace	0.09	trace
Influent	INF-1A	75	trace	trace	trace	0.27	trace
	INF-2A	68	trace	trace	trace	0.26	trace
	INF-3A	80	trace	trace	trace	0.30	trace
Effluent	EFF-1A	47.5	trace	trace	trace	0.22	trace
	EFF-2A	-	-	-	-	-	trace
	EFF-3A	37.5	trace	trace	trace	0.24	trace

- Not determined (indicates insufficient sample).

TABLE C6

GRASSY ISLAND: CONCENTRATION OF NITROGEN AND PHOSPHORUS SPECIES IN INFLUENT, EFFLUENT, AND BACKGROUND WATER SAMPLES

Sample ID		NH_3-N				ORGANIC N			
		Total mg/l	8-μ Filtrate mg/l	0.45-μ Filtrate mg/l	0.05-μ Filtrate mg/l	Total mg/l	8-μ Filtrate mg/l	0.45-μ Filtrate mg/l	0.05-μ Filtrate mg/l
Background Water	BW-A	trace	trace	trace	trace	1.10	0.96	0.80	0.80
Influent	INF-1A	70.2	34.9	32.6	-	111	7.13	5.59	-
	INF-2A	97.3	85.2	81.5	80.7	61.2	12.1	11.1	11.0
	INF-3A	-	1.90	1.60	1.20	2.39	1.08	0.77	0.24
Effluent	EFF-1A	13.8	13.1	12.4	-	2.23	2.15	1.83	-
	EFF-2A	14.0	13.2	13.9	-	2.87	2.20	0.83	-
	EFF-3A	14.8	13.2	12.8	12.8	2.60	1.60	1.75	1.76

Sample ID		TOTAL P				NO_3-N	NO_2-N
		Total mg/l	8-μ Filtrate mg/l	0.45-μ Filtrate mg/l	0.05-μ Filtrate mg/l	0.45-μ Filtrate mg/l	0.45-μ Filtrate mg/l
Background Water	BW-A	0.06	trace	trace	trace	0.10	trace
Influent	INF-1A	148	trace	trace	trace	0.22	trace
	INF-2A	230	trace	trace	trace	0.18	trace
	INF-3A	9.38	trace	trace	trace	0.20	trace
Effluent	EFF-1A	0.19	trace	trace	trace	0.10	trace
	EFF-2A	0.19	trace	trace	trace	0.11	trace
	EFF-3A	0.06	trace	trace	trace	0.12	trace

- Not determined (indicates insufficient sample).

TABLE C7

PINTO ISLAND: CONCENTRATION OF METALS IN INFLUENT, EFFLUENT, AND BACKGROUND WATER SAMPLES

Sample ID		Na Total* mg/l	Na 8-μ Filtrate mg/l	Na 0.45-μ Filtrate mg/l	Na 0.05-μ Filtrate mg/l	K Total* mg/l	K Solid+ mg/kg	K 8-μ Filtrate mg/l	K 0.45-μ Filtrate mg/l	K 0.05-μ Filtrate mg/l
Background Water	BW-B	-	1200	1200	-	-	-	-	-	-
	BW-C	-	1350	1350	1320	-	-	-	-	-
Influent	INF-1B	-	8700	-	7950	1110	14700	188	172	159
	INF-1C	-	8700	7950	7700	2700	56200	180	169	171
	INF-2B } INF-2C	- / -	8700∫	- / -	7650∫	1540∫	21800∫	178∫	173∫	171∫
	INF-3B	-	7950	7350	7200	1170∫	14700∫	191∫	184∫	156∫
	INF-3C	-	8250	7500	7350					
Effluent	EFF-1B	-	-	-	-	768	20600	129	123	111
	EFF-1C	-	6300	5700	5700	723	19900	128	125	121
	EFF-1D	-	6300	-	5700	923	27000	152	147	138
	EFF-1E	-	7350	-	5700	653	21100	144	135	133
	EFF-2B	-	6300	-	6000	785	22800	129	123	118
	EFF-2C	-	7050	-	-	583	16500	123	118	113
	EFF-2D	-	7350	-	6150	781	18900	124	117	114
	EFF-2E	-	6900	6600	-	641	17800	116	108	98
	EFF-3B	-	-	-	-	777	20000	155	142	133
	EFF-3C	-	-	-	-	863	-	134	128	152
	EFF-3D	-	-	-	-	751	14100	143	132	127
	EFF-3E	-	6300	-	-	693	16000	149	153	156

(Continued)

* Based on wet slurry sample.
\+ Based on dry weight of sample.
∫ Composite sample.
\- Not determined (indicates insufficient sample or sample destroyed in transit).

Table C7 (Continued)

Sample ID		Ca Total* mg/l	Ca Solid+ mg/kg	Ca 8-μ Filtrate mg/l	Ca 0.45-μ Filtrate mg/l	Ca 0.05-μ Filtrate mg/l	Mg Total* mg/l	Mg Solid+ mg/kg	Mg 8-μ Filtrate mg/l	Mg 0.45-μ Filtrate mg/l	Mg 0.05-μ Filtrate mg/l
Background Water	BW-B	66.3	15800	65.0	63.3	62.8	-	-	215	210	195
	BW-C	69.7	13900	66.5	65.2	61.4	-	-	229	223	189
Influent	INF-1B	623	8260	455	453	447	-	-	1440	1312	1218
	INF-1C	652	13600	455	438	423	-	-	1510	1420	1312
	INF-2B, INF-2C	679∫	9610	450∫	457∫	418∫	-	-	1150∫	1022∫	966∫
	INF-3B, INF-3C	718∫	903∫	520∫	499∫	473∫	-	-	1225∫	1130∫	1165∫
Effluent	EFF-1B	423	11400	279	255	237	-	-	759	752	892
	EFF-1C	449	12400	291	278	255	-	-	889	884	857
	EFF-1D	543	15900	340	323	315	-	-	1015	972	862
	EFF-1E	517	16700	332	318	295	-	-	1175	820	787
	EFF-2B	437	12700	294	286	273	-	-	1182	1004	1015
	EFF-2C	425	12000	275	269	263	-	-	1021	959	852
	EFF-2D	517	12500	362	352	343	-	-	1024	994	973
	EFF-2E	537	14900	317	295	288	-	-	1280	976	1033
	EFF-3B	530	13600	415	398	217	-	-	1240	1137	1099
	EFF-3C	618	-	375	356	348	-	-	990	980	871
	EFF-3D	585	11000	278	255	247	-	-	953	871	792
	EFF-3D	573	13200	363	352	359	-	-	1220	1155	1046

(Continued)

* Based on wet slurry sample.
\+ Based on dry weight of sample.
∫ Composite sample.
\- Not determined (indicates insufficient sample or sample destroyed in transit).

Table C7 (Continued)

Sample ID		Cd Total* µg/l	Cd Solid + mg/kg	Cd 8-µ Filtrate µg/l	Cd 0.45-µ Filtrate µg/l	Cd 0.05-µ Filtrate µg/l	Cu Total* mg/l	Cu Solid+ mg/kg	Cu 8-µ Filtrate µg/l	Cu 0.45-µ Filtrate µg/l	Cu 0.05-µ Filtrate µg/l
Background Water	BW-B	2.63	0.63	0.87	0.98	0.73	0.31	73	2.15	2.11	2.00
	BW-C	2.12	0.42	1.11	0.87	0.66	0.55	110	1.83	1.98	1.72
Influent	INF-1B	100	1.33	3.75	3.18	2.93	1.79	23.7	2.41	2.33	1.73
	INF-1C	101	2.10	3.0	2.79	2.62	2.17	45.2	6.17	5.33	5.21
	INF-2B }	101	1.88	3.39ʃ	2.47ʃ	2.77ʃ	2.28	42.5	5.52ʃ	4.38ʃ	2.33ʃ
	INF-2C }	104	1.19				3.01	34.4			
	INF-3B }	63	0.57	3.41ʃ	3.33ʃ	2.43ʃ	2.71	56.5	4.27ʃ	3.82ʃ	3.17ʃ
	INF-3C }	67	1.40				4.41	91.7			
Effluent	EFF-1B	61	1.64	4.56	3.42	3.33	1.32	35.5	4.77	4.31	4.32
	EFF-1C	48.9	1.35	4.11	3.41	3.62	0.97	26.7	8.11	7.31	7.19
	EFF-1D	47.4	1.39	0.43	0.21	0.17	1.17	34.2	5.22	4.58	4.29
	EFF-1E	71.8	2.32	3.73	2.45	2.17	0.67	21.7	6.98	6.63	6.37
	EFF-2B	51.5	1.50	0.77	0.52	0.43	1.39	40.4	3.11	2.93	3.23
	EFF-2C	84	2.37	2.56	2.31	1.68	2.34	66.1	4.55	3.85	3.56
	Eff-2D	72.3	1.75	2.79	2.20	2.00	0.78	18.8	3.34	2.86	2.17
	EFF-2E	69.5	1.93	4.87	3.72	3.18	1.67	46.3	7.91	7.43	5.89
	EFF-3B	93.5	2.40	0.44	0.43	0.39	1.53	39.3	4.05	3.56	3.22
	EFF-3C	94.5	-	2.23	1.12	0.83	1.77	-	5.72	5.65	4.75
	EFF-3D	88.9	1.67	5.23	4.21	3.92	0.70	13.2	4.85	4.22	3.91
	EFF-3E	93.7	2.16	3.31	2.79	2.34	1.37	31.6	6.71	6.58	5.21

(Continued)

* Based on wet slurry sample.
\+ Based on dry weight of sample.
ʃ Composite sample.
\- *Not determined* (*indicates insufficient sample* or sample destroyed in transit).

Table C7 (Continued)

Sample ID		Fe Total* mg/l	Fe Solid + mg/kg	Fe 8-μ Filtrate μg/l	Fe 0.45-μ Filtrate μg/l	Fe 0.05-μ Filtrate μg/l	Hg Total* μg/l	Hg Solid+ mg/kg	Hg 8-μ Filtrate μg/l	Hg 0.45-μ Filtrate μg/l	Hg 0.05-μ Filtrate μg/l
Background Water	BW-B	-	-	3.92	4.2	1.3	trace	-	0.05	0.05	0.05
	BW-C	-	-	4.62	1.4	1.2	trace	-	0.02	0.02	trace
Influent	INF-1B	2400	31800	750	350	310	27	0.34	0.23	0.17	0.18
	INF-1C	1660	34600	31.0	34.7	15.6	31	0.65	0.23	0.20	0.20
	INF-2B }	1760	32800	59.9∫	56.4∫	52.1∫	43	0.80	0.26∫	0.21∫	0.24∫
	INF-2C	2400	27400				48	0.55			
	INF-3B }	4080	36800	32.4∫	29.4∫	29.3∫	21	0.20	0.38∫	0.32∫	0.27∫
	INF-3C	1460	30400				37	0.77			
Effluent	EFF-1B	1140	30600	42.1	16.4	9.3	17	0.46	0.33	0.32	0.33
	EFF-1C	1340	36900	43.7	6.1	5.8	20	0.55	0.33	0.29	0.28
	EFF-1D	1210	35400	37.8	7.1	2.7	24	0.70	0.18	0.17	0.17
	EFF-1E	903	29200	245	3.5	7.4	23	0.74	0.19	0.15	0.16
	EFF-2B	863	25100	20.8	6.3	3.8	21	0.61	0.21	0.20	0.22
	EFF-2C	1310	37000	22.5	5.3	2.4	28	0.79	0.21	0.17	0.17
	EFF-2D	1440	34800	12.0	35.2	24.1	30	0.72	0.08	0.06	0.07
	EFF-2E	1080	29900	195	36.2	30.6	22	0.61	0.09	0.08	0.08
	EFF-3B	1260	32400	32.7	17.6	13.5	24	0.62	0.22	0.18	0.18
	EFF-3C	1390	-	77.6	55.1	32.8	19	-	0.26	0.22	0.23
	EFF-3D	1450	27300	134	32.4	28.7	17	0.32	0.08	0.06	0.07
	EFF-3E	1400	32300	283	14.2	3.9	18	0.41	0.07	0.06	0.06

(Continued)

* Based on wet slurry sample.
\+ Based on dry weight of sample.
∫ Composite sample.
\- Not determined (indicates insufficient sample or sample destroyed in transit).

Table C7 (Continued)

Sample ID		Mn Total* mg/l	Mn Solid+ mg/kg	Mn 8-μ Filtrate μg/l	Mn 0.45-μ Filtrate μg/l	Mn 0.05-μ Filtrate μg/l	Ni Total* mg/l	Ni Solid+ mg/kg	Ni 8-μ Filtrate μg/l	Ni 0.45-μ Filtrate μg/l	Ni 0.05-μ Filtrate μg/l
Background Water	BW-B	2.3	547	-	-	-	0.006	-	5.11	4.9	4.23
	BW-C	-	-	-	-	-	0.002	-	1.83	1.7	1.8
Influent	INF-1B	33.3	442	5.17	5.00	4.78	1.31	17.4	8.24	7.13	7.31
	INF-1C	41.6	866	4.92	4.72	4.55	1.52	12.8	9.76	8.32	8.3
	INF-2B}	48.8	908	4.98∫	4.91∫	4.75∫	1.76	32.8	8.44∫	8.32∫	8.23∫
	INF-2C}	44.6	509				2.03	23.2			
	INF-3B}	50.6	456	5.22∫	4.94∫	4.82∫	3.11	28.0	7.32∫	6.87∫	6.31∫
	INF-3C}	53.7	1118				1.27	26.5			
Effluent	EFF-1B	17.0	457	3.71	3.56	3.44	0.51	13.7	6.32	6.87	6.32
	EFF-1C	19.3	532	3.98	3.72	3.56	0.73	20.1	8.88	7.99	7.93
	EFF-1D	15.3	447	3.33	3.14	3.11	0.44	12.9	7.32	6.58	6.39
	EFF-1E	16.9	547	4.56	4.42	4.33	0.63	20.4	10.43	8.32	7.91
	EFF-2B	12.6	366	4.01	3.86	3.62	0.81	23.5	9.57	9.51	8.75
	EFF-2C	9.7	274	4.13	3.93	3.92			6.78	6.21	5.95
	EFF-2D	20.9	505	3.62	3.55	3.34	0.78	18.8	7.13	6.73	6.2
	EFF-2E	28.3	784	3.91	3.72	3.52	0.51	14.1	6.41	5.93	5.90
	EFF-3B	23.4	601	2.45	2.37	2.11	0.44	11.3	9.32	7.72	6.51
	EFF-3C	27.7	-	5.11	4.77	4.54	0.56	-	5.42	5.23	4.95
	EFF-3D	30.5	573	3.91	3.83	3.87			6.72	5.79	5.51
	EFF-3E	28.7	663	3.72	3.77	3.56			9.21	8.02	6.32

(Continued)

* Based on wet slurry sample.
\+ Based on dry weight of sample.
∫ Composite sample.
\- Not determined (indicates insufficient sample or sample destroyed in transit).

Table C7 (Continued)

	Sample ID	Pb Total* mg/l	Pb Solid+ mg/kg	Pb 8-μ Filtrate μg/l	Pb 0.45-μ Filtrate μg/l	Pb 0.05-μ Filtrate μg/l	Se Total* mg/l	Se Solid+ mg/kg	Se 8-μ Filtrate μg/l	Se 0.45-μ Filtrate μg/l	Se 0.05-μ Filtrate μg/l
Background Water	BW-B	0.52	123	1.77	1.72	1.17	-	-	0.59	0.61	0.51
	BW-C	0.37	74	1.13	1.11	0.92	-	-	0.47	0.50	0.47
Influent	INF-1B	5.20	69.0	5.55	5.31	4.17	2.88	38.2	1.71	1.61	-
	INF-1C	3.52	73.3	6.42	5.89	5.22	2.73	56.9	4.18	3.91	-
	INF-2B}	5.57	104	7.31ʃ	6.83ʃ	6.53ʃ	3.77	70.2	4.51ʃ	4.41ʃ	4.47ʃ
	INF-2C}	6.21	70.9				3.11	35.5			
	INF-3B}	6.81	61.4	6.87ʃ	6.55ʃ	6.03ʃ	3.43	30.9	-	-	-
	INF-3C}	4.02	83.8				2.68	55.8	-	-	-
Effluent	EFF-1B	1.88	50.5	5.11	4.89	4.75	1.42	38.2	3.99	3.71	3.23
	EFF-1C	1.70	46.8	3.99	3.82	3.39	2.33	64.2	2.34	2.14	1.82
	EFF-1D	2.03	59.4	4.25	3.93	3.27	0.98	28.7	2.18	1.96	1.97
	EFF-1E	3.15	101.9	4.92	4.52	4.11	1.73	55.9	2.73	2.76	2.34
	EFF-2B	3.06	88.9	5.83	5.11	4.73	2.02	58.7	4.73	3.80	3.34
	EFF-2C	3.24	91.5	4.13	3.72	2.88	2.54	71.8	2.97	2.79	2.77
	EFF-2D	3.38	81.6	5.22	4.75	4.37	2.38	57.5	2.49	2.41	2.36
	EFF-2E	3.48	96.4	4.38	3.97	3.24	1.15	31.9	2.73	2.61	2.45
	EFF-3B	3.07	78.9	4.69	4.55	4.12	1.31	33.7	3.53	3.34	3.16
	EFF-3C	8.83	-	5.21	4.73	4.28	2.07	-	1.97	1.70	1.56
	EFF-3D	3.29	61.8	4.13	3.83	3.87	2.63	49.4	1.83	1.69	1.47
	EFF-3E	3.71	85.7	3.88	3.72	3.22	2.11	48.7	2.73	2.52	2.31

(Continued)

* Based on wet slurry sample.
\+ Based on dry weight of sample.
ʃ Composite sample.
\- Not determined (indicates insufficient sample or sample destroyed in transit).

Table C7 (Continued)

Sample ID		Ti Total* mg/l	Ti Solid+ mg/kg	Ti 8-μ Filtrate μg/l	Ti 0.45-μ Filtrate μg/l	Ti 0.05-μ Filtrate μg/l	V Total* mg/l	V Solid+ mg/kg	V 8-μ Filtrate μg/l	V 0.45-μ Filtrate μg/l	V 0.05-μ Filtrate μg/l
Background Water	BW-B	trace	-	trace	trace	trace	-	-	trace	trace	trace
	BW-C	trace	-	trace	trace	trace	-	-	trace	trace	trace
Influent	INF-1B	4.31	57.2	3.93	3.87	-	3.21	42.6	6.17	5.87	5.21
	INF-1C	3.87	80.6	4.17	4.22	-	3.87	79.8	6.55	6.47	5.88
	INF-2B}	5.83	108.6	5.38ʃ	5.22ʃ	5.14ʃ	3.76	70.0	7.81ʃ	7.31ʃ	7.01ʃ
	INF-2C	6.71	76.6				3.73	42.6			
	INF-3B}	6.31	56.8	3.83ʃ	3.97ʃ	3.83ʃ	4.33	39.0	9.73ʃ	8.17ʃ	8.23ʃ
	INF-3C	4.41	91.9				3.17	66.0			
Effluent	EFF-1B	3.71	99.7	3.41	3.38	3.22	2.02	54.3	2.47	2.31	2.11
	EFF-1C	3.21	88.4	2.72	2.65	2.17	2.16	59.5	2.83	2.45	2.33
	EFF-1D	3.28	95.9	2.13	1.95	1.72	1.73	50.6	2.51	2.36	1.97
	EFF-1E	2.77	89.6	3.71	3.67	3.17	1.58	51.1	4.13	3.92	3.38
	EFF-2B	2.75	79.9	2.93	2.84	2.83	1.63	47.4	4.83	4.54	4.34
	EFF-2C	2.31	65.3	4.38	4.23	4.17	1.66	46.9	5.21	5.67	5.11
	EFF-2D	2.32	56.0	2.83	2.78	2.63	1.21	29.2	3.27	3.87	3.47
	EFF-2E	2.28	63.2	2.79	2.62	2.58	1.15	31.9	3.79	3.47	3.14
	EFF-3B	2.23	61.8	3.31	3.11	3.17	2.13	54.8	5.76	5.32	5.83
	EFF-3C	2.44	-	4.52	4.33	4.27	2.78	-	6.43	6.27	6.03
	EFF-3D	2.67	50.2	2.38	2.11	2.04	4.13	77.6	4.37	4.21	4.21
	EFF-3E	2.87	66.3	2.97	2.77	2.63	2.11	48.7	3.82	3.87	3.56

(Continued)

* Based on wet slurry sample.
\+ Based on dry weight of sample.
ʃ Composite sample.
\- Not determined (indicates insufficient sample or sample destroyed in transit).

Table C7 (Concluded)

Sample ID		Zn Total* mg/l	Zn Solid+ mg/kg	Zn 8-μ Filtrate μg/l	Zn 0.45-μ Filtrate μg/l	Zn 0.05-μ Filtrate μg/l
Background Water	BW-B	1.12	-	0.52	1.68	1.32
	BW-C	1.13	-	0.33	0.63	0.56
Influent	INF-1B	18.5	245	3.6	trace	trace
	INF-1C	10.5	219	1.4	trace	trace
	INF-2B }	12.4	230	trace∫	trace∫	trace∫
	INF-2C }	20.6	235			
	INF-3B }	22.9	206	1.2∫	1.13∫	1.12∫
	INF-3C }	13.7	285			
Effluent	EFF-1B	11.2	300	0.72	1.95	1.93
	EFF-1C	9.7	267	0.43	0.87	1.11
	EFF-1D	9.8	287	0.23	0.50	0.38
	EFF-1E	9.2	298	1.31	1.62	1.32
	EFF-2B	6.8	198	0.49	1.90	1.78
	EFF-2C	7.3	206	0.88	1.91	1.53
	EFF-2D	12.1	292	0.22	1.66	1.43
	EFF-2E	9.6	266	1.37	0.56	0.63
	EFF-3B	11.9	306	0.11	0.55	0.43
	EFF-3C	13.5	-	2.95	0.62	1.17
	EFF-3D	14.1	265	3.68	0.88	0.62
	EFF-3E	13.3	307	1.88	0.29	0.17

* Based on wet slurry sample.

\+ Based on dry weight of sample.

∫ Composite sample.

\- Not determined (indicates insufficient sample or sample destroyed in transit).

TABLE C8

GRASSY ISLAND: CONCENTRATION OF METALS IN INFLUENT, EFFLUENTS, AND BACKGROUND WATER SAMPLES

Sample ID		Na Total* mg/l	Na 8-μ Filtrate mg/l	Na 0.45-μ Filtrate mg/l	Na 0.05-μ Filtrate mg/l	K Total* mg/l	K Solid+ mg/kg	K 8-μ Filtrate mg/l	K 0.45-μ Filtrate mg/l	K 0.05-μ Filtrate mg/l
Background Water	BW-A	-	29.5	13.5	13.0	-	-	-	-	-
Influent	INF-1B	-	24.5	23.5	20.5	492	2450	173	167	152
	INF-1C	225	-	-	-	518	3120	135	128	123
	INF-2B	245	-	25.0∫	21.0∫	1217∫	6160∫	138∫	126∫	118∫
	INF-2C	-	-							
	INF-3B	-	-	25.0∫	-	1315∫	6940∫	147∫	132∫	123∫
	INF-3C	-	-		-					
Effluent	EFF-1B	-	-	30.5	29.0	330	-	113	107	109
	EFF-1C	-	-	32.0	22.5	379	-	117	111	102
	EFF-2B	-	26.5	23.5	21.0	427	-	153	148	137
	EFF-2C	-	29.0	-	18.0	452	-	168	156	152
	EFF-3B	-	30.5	-	25.0	158	-	73.1	78.5	75.9
	EFF-3C	-	29.0	-	21.0	323	-	114	107	105

(Continued)

* Based on wet slurry sample.
\+ Based on dry weight of sample.
∫ Composite sample.
\- Not determined (indicates insufficient sample or sample destroyed in transit).

Table C8 (Continued)

Sample ID		Ca					Mg				
		Total* mg/l	Solid+ mg/kg	8-μ Filtrate mg/l	0.45-μ Filtrate mg/l	0.05-μ Filtrate mg/l	Total* mg/l	Solid+ mg/kg	8-μ Filtrate mg/l	0.45-μ Filtrate mg/l	0.05-μ Filtrate mg/l
Background Water	BW-A	4.51	-	4.42	3.38	3.42	9.2	-	8.8	8.0	8.9
Influent	INF-1B	72.8	407	57.2	56.3	52.8	156.3	873	53.5	49.7	33.8
	INF-1C	55.7	336	43.9	42.7	41.6	137.4	828	61.5	52.1	46.8
	INF-2B, INF-2C	61.7∫	312∫	53.7∫	52.5∫	49.3∫	128.3∫	650∫	56.7∫	40.5∫	36.5∫
	INF-3B, INF-3C	59.2∫	312∫	44.3∫	43.7∫	41.8∫	273.4∫	1440∫	179.3∫	176.2∫	170.9∫
Effluent	EFF-1B	43.8	-	36.4	35.6	33.6	123.7	-	55.1	52.1	43.6
	EFF-1C	33.3	-	30.1	29.7	27.7	156.3	-	29.3	29.7	31.7
	EFF-2B	40.7	-	34.8	33.6	31.4	183.4	-	42.6	38.3	32.3
	EFF-2C	28.3	-	25.6	23.6	21.9	168.7	-	33.4	33.0	21.0
	EFF-3B	35.3	-	32.7	29.4	27.3	157.4	-	32.0	33.5	33.0
	EFF-3C	28.4	-	25.2	22.3	21.4	149.3	-	37.0	34.5	36.0

(Continued)

* Based on wet slurry sample.
\+ Based on dry weight of sample.
∫ Composite sample.
\- Not determined (indicates insufficient sample or sample destroyed in transit).

Table C8 (Continued)

Sample ID		Cd Total* µg/l	Cd Solid+ mg/kg	Cd 8-µ Filtrate µg/l	Cd 0.45-µ Filtrate µg/l	Cd 0.05-µ Filtrate µg/l	Cu Total* mg/l	Cu Solid+ mg/kg	Cu 8-µ Filtrate µg/l	Cu 0.45-µ Filtrate µg/l	Cu 0.05-µ Filtrate µg/l
Background Water	BW-A	1.27	-	0.12	0.13	0.09	0.27	-	2.6	2.1	2.3
Influent	INF-1B	381	2.13	2.83	2.75	2.32	20.1	112	10.3	9.1	8.1
	INF-1C	400	2.41	10.95	7.87	6.33	26.7	160	9.1	8.2	7.3
	INF-2B }	580	3.09	3.91ʃ	3.79ʃ	3.56ʃ	233	123	11.8ʃ	9.3ʃ	8.1ʃ
	INF-2C }	710	3.44				243	118			
	INF-3B }	330	1.40	2.81ʃ	2.94ʃ	2.48ʃ	21.1	88	17.4ʃ	15.2ʃ	14.9ʃ
	INF-3C }	210	1.51				18.7	134			
Effluent	EFF-1B	2.46	-	0.78	0.63	0.55	1.63	-	6.4	5.8	4.9
	EFF-1C	1.31	-	0.83	0.81	0.76	1.87	-	3.4	2.9	1.7
	EFF-2B	2.89	-	0.42	0.39	0.31	1.14	-	7.8	6.3	6.2
	EFF-2C	1.49	-	1.17	1.98	1.16	1.39	-	3.0	2.8	2.2
	EFF-3B	-	-	0.89	0.73	0.62	1.93	-	4.3	4.4	4.1
	EFF-3C	1.15	-	1.23	1.07	0.84	1.76	-	8.7	8.2	7.5

(Continued)

* Based on wet slurry sample.
\+ Based on dry weight of sample.
ʃ Composite sample.
\- Not determined (indicates insufficient sample or sample destroyed in transit).

Table C8 (Continued)

Sample ID		Fe Total* mg/l	Fe Solid+ mg/kg	Fe 8-μ Filtrate μg/l	Fe 0.45-μ Filtrate μg/l	Fe 0.05-μ Filtrate μg/l
Background Water	BW-A	0.03	-	13.5	5.5	4.3
Influent	INF-1B	6830	38200	532	29	15.7
	INF-1C	5020	30200	789	35	30.6
	INF-2B }	5080	26900	599ʃ	302ʃ	157ʃ
	INF-2C	5780	28100			
	INF-3B }	6130	25500	845ʃ	179ʃ	148ʃ
	INF-3C	4870	35000			
Effluent	EFF-1B	37.8	-	9.9	6.3	6.8
	EFF-1C	48.2	-	10.1	12.7	8.5
	EFF-2B	50.1	-	3.95	2.7	1.6
	EFF-2C	51.3	-	2.2	3.2	3.2
	EFF-3B	47.2	-	6.7	2.7	1.6
	EFF-3C	46.3	-	5.8	3.6	2.5

* Based on wet slurry sample.
\+ Based on dry weight of sample.
ʃ Composite sample.
\- Not determined (indicates insufficient sample or sample destroyed in transit).

(Continued)

Table C8 (Continued)

Sample ID		Hg Total* µg/l	Hg Solid+ mg/kg	Hg 8-µ Filtrate µg/l	Hg 0.45-µ Filtrate µg/l	Hg 0.05-µ Filtrate µg/l	Mn Total* mg/l	Mn Solid+ mg/kg	Mn 8-µ Filtrate µg/l	Mn 0.45-µ Filtrate µg/l	Mn 0.05-µ Filtrate µg/l
Background Water	BW-A	1.0	-	0.07	0.07	0.05	-	-	2	2	2
Influent	INF-1B	76	0.42	0.32	0.24	0.13	15.6	87.2	78	63	58
	INF-1C	83	0.50	0.20	0.15	0.08	17.3	104	83	89	83
	INF-2B }	112	0.59	0.22∫	0.17∫	0.14∫	28.4	137	95∫	89∫	82∫
	INF-2C }	72	0.35				22.6	109			
	INF-3B }	89	0.37	0.23∫	0.19∫	0.18∫	35.2	147	92∫	83∫	81∫
	INF-3C }	77	0.55				37.3	268			
Effluent	EFF-1B	3.6	-	0.20	0.20	0.14	1.08	-	92	53	49
	EFF-1C	3.2	-	0.34	0.20	0.18	0.73	-	73	71	78
	EFF-2B	4.8	-	0.17	0.15	0.13	0.58	-	53	49	38
	EFF-2C	2.2	-	0.22	0.15	0.13	0.63	-	58	52	51
	EFF-3B	3.7	-	0.18	0.15	0.13	0.23	-	52	47	43
	EFF-3C	1.3	-	0.34	0.22	0.08	0.38	-	47	38	35

(Continued)

* Based on wet slurry sample.
\+ Based on dry weight of sample.
∫ Composite sample.
\- Not determined (indicates insufficient sample or sample destroyed in transit).

Table C8 (Continued)

Sample ID		Ni Total* mg/l	Ni Solid+ mg/kg	Ni 8-μ Filtrate μg/l	Ni 0.45-μ Filtrate μg/l	Ni 0.05-μ Filtrate μg/l	Pb Total* mg/l	Pb Solid+ mg/kg	Pb 8-μ Filtrate μg/l	Pb 0.45-μ Filtrate μg/l	Pb 0.05-μ Filtrate μg/l
Background Water	BW-A	0.004	-	2.83	2.7	2.2	0.047	-	-	-	1.1
Influent	INF-1B	9.3	52.0	14.6	14.1	14.7	11.8	65.9	4.83	4.45	4.13
	INF-1C	7.8	47.0	13.9	13.3	12.0	12.1	72.9	5.12	1.20	4.39
	INF-2B }	11.7	61.9	15.9ʃ	-	14.8ʃ	13.7	72.5	6.83ʃ	6.17ʃ	5.82ʃ
	INF-2C }	15.3	74.3				12.5	60.7			
	INF-3B }	14.3	59.6	16.3ʃ	15.8ʃ	14.7ʃ	13.3	55.4	7.18ʃ	6.67ʃ	6.55ʃ
	INF-3C }	10.6	76.3				10.3	74.1			
Effluent	EFF-1B	0.82	-	15.7	13.3	13.2	0.182	-	5.68	5.14	5.07
	EFF-1C	0.87	-	16.3	14.2	12.1	0.079	-	7.80	7.54	7.32
	EFF-2B	0.32	-	16.3	16.3	15.3	0.098	-	9.94	9.28	9.23
	EFF-2C	0.45	-	12.0	10.2	9.72	0.046	-	5.43	5.11	5.28
	EFF-3B	0.17	-	11.3	11.7	11.1	0.155	-	4.91	4.37	4.22
	EFF-3C	0.57	-	12.6	12.3	12.4	0.068	-	5.55	5.14	4.82

(Continued)

* Based on wet slurry sample.
\+ Based on dry weight of sample.
ʃ Composite sample.
\- Not determined (indicates insufficient sample or sample destroyed in transit).

Table C8 (Continued)

Sample ID		Se Total* mg/l	Se Solid+ mg/kg	Se 8-μ Filtrate μg/l	Se 0.45-μ Filtrate μg/l	Se 0.05-μ Filtrate μg/l	Ti Total* mg/l	Ti Solid+ mg/kg	Ti 8-μ Filtrate μg/l	Ti 0.45-μ Filtrate μg/l	Ti 0.05-μ Filtrate μg/l
Background Water	BW-A	0.008	-	trace	trace	trace	trace	-	-	-	-
Influent	INF-1B	4.68	26.1	1.78	1.55	0.37	8.61	48.1	2.19	1.98	1.47
	INF-1C	5.19	31.3	1.70	1.67	1.31	7.65	46.1	1.90	1.90	1.30
	INF-2B }	5.13	27.1	1.95ʃ	-	1.54ʃ	7.53	39.8	2.10ʃ	1.83ʃ	1.82ʃ
	INF-2C }	5.46	26.5				8.34	40.5			
	INF-3B }	5.61	23.4	2.15ʃ	1.72ʃ	0.78ʃ	9.21	38.4	1.71ʃ	1.64ʃ	1.44ʃ
	INF-3C }	3.63	26.1				8.43	60.6			
Effluent	EFF-1B	0.204	-	trace	trace	trace	0.27	-	1.68	1.53	1.48
	EFF-1C	0.131	-	2.01	1.83	1.12	0.19	-	1.91	1.72	1.53
	EFF-2B	0.125	-	trace	trace	-	0.37	-	1.33	1.89	1.56
	EFF-2C	0.173	-	trace	trace	trace	0.25	-	1.76	1.46	1.47
	EFF-3B	0.188	-	trace	trace	trace	0.30	-	1.0	0.83	1.43
	EFF-3C	0.123	-	2.03	1.32	0.45	0.16	-	1.51	1.24	1.11

(Continued)

* Based on wet slurry sample.
\+ Based on dry weight of sample.
ʃ Composite sample.
\- Not determined (indicates insufficient sample or sample destroyed in transit).

Table C8 (Concluded)

Sample ID		V					Zn				
		Total* mg/l	Solid+ mg/kg	8-μ Filtrate μg/l	0.45-μ Filtrate μg/l	0.05-μ Filtrate μg/l	Total* mg/l	Solid+ mg/kg	8-μ Filtrate μg/l	0.45-μ Filtrate μg/l	0.05-μ Filtrate μg/l
Background Water	BW-A	0.003	-	0.11	0.07	-	0.23	-	2.19	-	2.00
Influent	INF-1B	5.13	28.7	2.93	2.36	1.86	17.7	98.9	178	176	112
	INF-1C	5.19	31.3	3.21	2.95	2.63	16.8	101	275	107	105
	INF-2B }	5.61	29.7	4.28ʃ	3.87ʃ	3.54ʃ	20.7	110	158ʃ	112ʃ	68ʃ
	INF-2C }	6.09	29.6				37.1	180			
	INF-3B }	6.21	25.9	3.38ʃ	3.10ʃ	2.37ʃ	35.6	148	224ʃ	178ʃ	117ʃ
	INF-3C }	4.39	31.6				17.1	123			
Effluent	EFF-1B	0.17	-	3.84	3.21	2.81	0.40	-	0.66	0.11	0.23
	EFF-1C	0.31	-	4.21	2.86	2.24	0.44	-	1.76	1.51	1.53
	EFF-2B	0.12	-	2.43	2.13	1.75	0.94	-	0.59	0.61	0.73
	EFF-2C	0.18	-	1.87	1.48	1.13	0.33	-	2.74	2.66	2.53
	EFF-3B	0.15	-	1.94	1.17	1.21	0.38	-	2.18	2.22	1.89
	EFF-3C	0.32	-	2.81	2.87	2.22	0.36	-	3.11	2.78	2.31

* Based on wet slurry sample.
\+ Based on dry weight of sample.
ʃ Composite sample.
\- Not determined (*indicates insufficient sample* or sample destroyed in transit).

TABLE C9

PINTO ISLAND: CONCENTRATION OF DDE, DDD, DDT AND PCB SPECIES IN INFLUENT, EFFLUENT, AND BACKGROUND WATER SAMPLES

Sample ID		OP' DDD				PP' DDD			
		Total mg/l	2 hrs. Settling mg/l	12 hrs. Settling mg/l	48 hrs. Settling mg/l	Total mg/l	2 hrs. Settling mg/l	12 hrs. Settling mg/l	48 hrs. Settling mg/l
Background Water	BW-D	1	1	trace	trace	2	4	trace	trace
Influent	INF-1D	53	12	trace	trace	162	38	3	trace
	INF-2D	277	52	3	trace	362	85	5	trace
	INF-3D	486	92	7	trace	874	185	10	trace
Effluent	EFF-1F	40	-	-	-	73	-	-	-
	EFF-2F	123	-	-	-	162	-	-	-
	EFF-3F	171	-	-	-	186	-	-	-

Sample ID		OP' DDE				PP' DDE			
		Total mg/l	2 hrs. Settling mg/l	12 hrs. Settling mg/l	48 hrs. Settling mg/l	Total mg/l	2 hrs. Settling mg/l	12 hrs. Settling mg/l	48 hrs. Settling mg/l
Background Water	BW-D	2	2	trace	trace	4	13	trace	trace
Influent	INF-1D	66	15	trace	trace	233	113	14	1
	INF-2D	79	23	1	trace	266	129	16	1
	INF-3D	342	87	6	trace	828	353	42	4
Effluent	EFF-1D	20	-	-	-	59	-	-	-
	EFF-2D	37	-	-	-	98	-	-	-
	EFF-3D	63	-	-	-	171	-	-	-

(Continued)

- Not determined (indicates insufficient sample).

TABLE C9 (Continued)

Sample ID		OP' DDT				PP' DDT			
		Total mg/l	2 hrs. Settling mg/l	12 hrs. Settling mg/l	48 hrs. Settling mg/l	Total mg/l	2 hrs. Settling mg/l	12 hrs. Settling mg/l	48 hrs. Settling mg/l
Background Water	BW-D	trace	trace	trace	trace	trace	trace	trace	trace
Influent	INF-1D	47	31	3	trace	182	77	10	1
	INF-2D	283	168	40	5	362	400	48	4
	INF-3D	228	163	42	6	874	450	52	trace
Effluent	EFF-1D	trace	-	-	-	trace	-	-	-
	EFF-2D	trace	-	-	-	trace	-	-	-
	EFF-3D	trace	-	-	-	trace	-	-	-

Sample ID		TOTAL DDT			
		Total mg/l	2 hrs. Settling mg/l	12 hrs. Settling mg/l	48 hrs. Settling mg/l
Background Water	BW-D	9	20	trace	trace
Influent	INF-1D	743	436	30	2
	INF-2D	1870	857	113	10
	INF-3D	3390	1330	117	10
Effluent	EFF-1D	192	-	-	-
	EFF-2D	420	-	-	-
	EFF-3D	590	-	-	-

(Continued)

- Not determined (indicates insufficient sample).

TABLE C9 (Concluded)

Sample ID		AROCLOR 1242				AROCLOR 1254			
		Total mg/l	2 hrs. Settling mg/l	12 hrs. Settling mg/l	48 hrs. Settling mg/l	Total mg/l	2 hrs. Settling mg/l	12 hrs. Settling mg/l	48 hrs. Settling mg/l
Background Water	BW-D	trace	trace	trace	trace	trace	trace	trace	trace
Influent	INF-1D	370	90	20	trace	350	60	10	trace
	INF-2D	790	250	100	trace	380	60	10	trace
	INF-3D	1260	310	140	trace	600	100	30	trace
Effluent	EFF-1D	30	-	-	-	10	-	-	-
	EFF-2D	30	-	-	-	20	-	-	-
	EFF-3D	40	-	-	-	10	-	-	-

Sample ID		AROCLOR 1260				TOTAL PCB			
		Total mg/l	2 hrs. Settling mg/l	12 hrs. Settling mg/l	48 hrs. Settling mg/l	Total mg/l	2 hrs. Settling mg/l	12 hrs. Settling mg/l	48 hrs. Settling mg/l
Background Water	BW-D	trace	trace	trace	trace	trace	trace	trace	trace
Influent	INF-1D	110	30	1	trace	830	180	31	trace
	INF-2D	120	30	1	trace	1280	340	111	trace
	INF-3D	180	40	3	trace	2040	450	173	trace
Effluent	EFF-1D	1	-	-	-	41	-	-	-
	EFF-2D	2	-	-	-	52	-	-	-
	EFF-3D	1	-	-	-	51	-	-	-

- Not determined(indicates insufficient sample).

TABLE C10

GRASSY ISLAND: CONCENTRATION OF DDE, DDD, DDT
AND PCB SPECIES IN INFLUENT, EFFLUENT, AND BACKGROUND WATER SAMPLES

Sample ID		OP' DDE				PP' DDE			
		Total mg/l	2 hrs. Settling mg/l	12 hrs. Settling mg/l	48 hrs. Settling mg/l	Total mg/l	2 hrs. Settling mg/l	12 hrs. Settling mg/l	48 hrs. Settling mg/l
Background Water	BW-A	50	10	trace	trace	80	18	trace	trace
Influent	INF-1D	13300	3030	180	9	57200	24800	3110	300
	INF-2D	33400	7600	480	21	59200	25760	3230	300
	INF-3D	1800	410	25	10	6420	2800	350	30
Effluent	EFF-1D	40	-	-	-	300	-	-	-
	EFF-2D	84	-	-	-	380	-	-	-
	EFF-3D	32	-	-	-	60	-	-	-

Sample ID		OP' DDD				PP' DDD			
		Total mg/l	2 hrs. Settling mg/l	12 hrs. Settling mg/l	48 hrs Settling mg/l	Total mg/l	2 hrs. Settling mg/l	12 hrs. Settling mg/l	48 hrs. Settling mg/l
Background Water	BW-A	60	13	trace	trace	80	9	trace	trace
Influent	INF-1D	12100	2740	170	8	24100	5440	340	15
	INF-2D	15200	3460	220	10	78300	17800	1110	50
	INF-3D	1440	330	20	9	4600	1040	70	3
Effluent	EFF-1D	120	-	-	-	170	-	-	-
	EFF-2D	140	-	-	-	200	-	-	-
	EFF-3D	32	-	-	-	80	-	-	-

(Continued)

- Not determined (indicates insufficient sample).

Table C10 (Continued)

Sample ID		OP' DDT				PP' DDT			
		Total mg/l	2 hrs. Settling mg/l	12 hrs. Settling mg/l	48 hrs. Settling mg/l	Total mg/l	2 hrs. Settling mg/l	12 hrs. Settling mg/l	48 hrs. Settling mg/l
Background Water	BW	20	4	180	trace	40	18	trace	trace
Influent	INF-1D	7080	4720	1180	50	8940	3800	490	44
	INF-2D	11000	7280	1820	80	12500	5440	700	60
	INF-3D	1360	910	220	10	2100	870	110	1
Effluent	EFF-1D	80	-	-	-	60	-	-	-
	EFF-2D	60	-	-	-	80	-	-	-
	EFF-3D	10	-	-	-	2	-	-	-

Sample ID		TOTAL DDT			
		Total mg/l	2 hr. Settling mg/l	12 hrs. Settling mg/l	48 hrs. Settling mg/l
Background Water	BW	330	72	trace	trace
Influent	INF-1D	123000	44700	5480	426
	INF-2D	209000	67400	2560	521
	INF-3D	17700	6360	820	63
Effluent	EFF-1D	660	-	-	-
	EFF-2D	940	-	-	-
	EFF-3D	216	-	-	-

(Continued)

- Not determined (indicates insufficient sample).

Table C10 (Concluded)

Sample ID		AROCLOR 1242 Total mg/l	AROCLOR 1242 2 hrs. Settling mg/l	AROCLOR 1242 12 hrs. Settling mg/l	AROCLOR 1242 48 hrs. Settling mg/l	AROCLOR 1254 Total mg/l	AROCLOR 1254 2 hrs. Settling mg/l	AROCLOR 1254 12 hrs. Settling mg/l	AROCLOR 1254 48 hrs. Settling mg/l
Background Water	BW-A	200	100	trace	trace	10	1	trace	trace
Influent	INF-1D	61400	15300	3800	580	22000	3600	600	60
	INF-2D	98700	24000	6000	1000	24400	4000	600	80
	INF-3D	11600	3000	750	100	4200	200	100	15
Effluent	EFF-1D	600	-	-	-	80	-	-	-
	EFF-2D	1200	-	-	-	20	-	-	-
	EFF-3D	150	-	-	-	10	-	-	-

Sample ID		AROCLOR 1260 Total mg/l	AROCLOR 1260 2 hrs. Settling mg/l	AROCLOR 1260 12 hrs. Settling mg/l	AROCLOR 1260 48 hrs. Settling mg/l	Total PCB Total mg/l	Total PCB 2 hrs. Settling mg/l	Total PCB 12 hrs. Settling mg/l	Total PCB 48 hrs. Settling mg/l
Background Water	BW-A	1	0.1	trace	trace	210	100	trace	trace
Influent	INF-1D	6800	1100	180	20	90300	20000	4580	660
	INF-2D	9800	1600	260	30	133000	29600	6780	1110
	INF-3D	1100	180	30	3	16900	3880	880	118
Effluent	EFF-1D	20	-	-	-	700	-	-	-
	EFF-2D	10	-	-	-	1280	-	-	-
	EFF-3D	6	-	-	-	166	-	-	-

- Not determined (indicates insufficient sample).

TABLE C11

PINTO ISLAND: CONCENTRATION OF METALS IN OIL AND GREASE FRACTION IN INFLUENT, EFFLUENT, AND BACKGROUND WATER SAMPLES

Sample ID		As				Cd				Cr			
		Total µg/l	Oil & Grease Fraction µg/l	% of Total	ppm of dry Oil & Grease	Total µg/l	Oil & Grease Fraction µg/l	% of Total	pmm of dry Oil & Grease	Total µg/l	Oil & Grease Fraction µg/l	% of Total	ppm of dry Oil & Grease
Background Water	BW-B	-	-	-	-	2.63	trace	trace	trace	-	-	-	-
	BW-C	-	-	-	-	2.12	trace	trace	trace	-	-	-	-
Influent	INF-1B	-	0.58	-	.848	100	1.49	1.49	2.18	-	0.78	-	1.14
	INF-1C	-	0.53	-	1.14	101	1.33	1.32	2.86	-	0.32	-	.688
	INF-2B }	-	0.59	-	2.01	101	1.56	1.52	5.31	-	0.89	-	3.03
	INF-2C }	-		-		104				-		-	
	INF-3B }	-	0.55	-	1.10	63	1.77	2.72	3.54	-	0.93	-	1.86
	INF-3C }	-		-		67				-		-	
Effluent	EFF-1B	-	0.54	-	23.5	61	0.08	0.131	3.48	-	0.54	-	23.5
	EFF-1C	-	0.66	-	41.2	48.9	0.07	0.143	4.38	-	0.68	-	42.5
	EFF-1D	-	0.92	-	57.5	47.4	trace	trace	trace	-	0.32	-	20.0
	EFF-1E	-	0.38	-	6.67	71.8	trace	trace	trace	-	0.42	-	7.37
	EFF-2B	-	trace	-	trace	51.5	0.14	0.272	5.00	-	trace	-	trace
	EFF-2C	-	0.42	-	6.77	84	0.13	0.155	2.10	-	0.33	-	5.32
	EFF-2D	-	trace	-	trace	72.3	trace	trace	trace	-	0.21	-	9.55
	EFF-2E	-	trace	-	trace	69.5	0.12	0.173	2.40	-	0.43	-	8.60
	EFF-3B	-	trace	-	trace	93.5	trace	trace	trace	-	0.63	-	11.1
	EFF-3C	-	0.32	-	-	94.5	trace	trace	trace	-	0.49	-	-
	EFF-3D	-	trace	-	trace	88.9	trace	trace	trace	-	0.55	-	5.24
	EFF-3E	-	trace	-	trace	93.7	trace	trace	trace	-	0.69	-	11.0

(Continued)

- Not determined (indicates insufficient sample).

Table C11 (Continued)

Sample ID		Cu				Fe				Mn			
		Total mg/l	Oil & Grease Fraction μg/l	% of Total	ppm of dry Oil & Grease	Total mg/l	Oil & Grease Fraction μg/l	% of Total	ppm of dry Oil & Grease	Total mg/l	Oil & Grease Fraction μg/l	% of Total	pmm of dry Oil & Grease
Background Water	BW-B	0.31	1.13	0.365	283	-	1.81	-	453	2.3	trace	trace	trace
	BW-C	0.55	2.14	0.389	713	-	1.53	-	510	-	trace	-	trace
Influent	INF-1B	1.79	4.23	0.236	6.18	2400	82.3	0.003	120	33.3	1.73	0.005	2.53
	INF-1C	2.17	3.77	0.174	8.11	1660	680	0.041	1460	41.6	1.54	0.004	3.31
	INF-2B}	2.28	3.74	0.141	12.7	1760	576	0.028	1960	48.8	2.11	0.005	7.18
	INF-2C	3.01				2400				44.6			
	INF-3B}	2.71	2.31	0.065	4.62	4080	1490	0.054	2980	50.6	1.52	0.003	3.04
	INF-3C	4.41				1460				53.7			
Effluent	EFF-1B	1.32	2.38	0.180	103	1140	2.73	0.0002	119	17.0	1.47	0.009	63.9
	EFF-1C	0.97	2.57	0.265	161	1340	2.48	0.0002	155	19.3	1.38	0.007	86.3
	EFF-1D	1.17	1.94	0.166	121	1210	2.07	0.0002	129	15.3	0.23	0.002	14.4
	EFF-1E	0.67	3.38	0.504	59.3	903	4.22	0.0005	74.0	16.9	1.47	0.009	25.8
	EFF-2B	1.39	3.54	0.255	126	863	3.57	0.0004	128	12.6	1.52	0.012	54.3
	EFF-2C	2.34	1.87	0.080	30.2	1310	3.62	0.0003	58.4	9.7	0.93	0.010	15.0
	EFF-2D	0.78	4.28	0.549	195	1440	3.24	0.0002	147	20.9	1.55	0.007	70.5
	EFF-2E	1.67	1.38	0.083	27.6	1080	4.43	0.0004	88.6	28.3	1.53	0.005	30.6
	EFF-3B	1.53	2.11	0.138	37.0	1260	3.72	0.0003	65.3	23.4	1.47	0.006	25.8
	EFF-3C	1.77	2.19	0.124	-	1390	3.76	0.0003	-	27.7	1.58	0.006	-
	EFF-3D	0.70	2.40	0.343	22.9	1450	3.93	0.0003	37.4	30.5	1.63	0.005	15.5
	EFF-3E	1.37	2.15	0.157	34.1	1400	7.48	0.0005	119	28.7	1.78	0.006	28.3

(Continued)

- Not determined (indicates insufficient sample).

Table C11 (Continued)

Sample ID		Ni Total mg/l	Ni Oil & Grease Fraction μg/l	Ni % of Total	Ni ppm of dry Oil & Grease	Pb Total mg/l	Pb Oil & Grease Fraction μg/l	Pb % of Total	Pb ppm of dry Oil & Grease	Ti Total mg/l	Ti Oil & Grease Fraction μg/l	Ti % of Total	Ti ppm of dry Oil & Grease
Background Water	BW-B	0.006	trace	trace	trace	0.52	trace	trace	trace	trace	-	-	-
	BW-C	0.002	trace	trace	trace	0.37	trace	trace	trace	trace	-	-	-
Influent	INF-1B	1.31	5.53	0.422	8.08	5.20	2.38	0.046	3.48	4.31	0.55	0.013	.804
	INF-1C	1.52	4.17	0.274	8.97	3.52	3.39	0.096	7.29	3.87	0.69	0.018	1.48
	INF-2B }	1.76	4.33	0.228	14.7	5.57	4.43	0.075	15.1	5.83	0.67	0.011	2.28
	INF-2C	2.03				6.21				6.71			
	INF-3B }	3.11	4.14	0.189	8.29	6.81	5.27	0.097	10.6	6.31	0.72	0.013	1.44
	INF-3C	1.27				4.02				4.41			
Effluent	EFF-1B	0.51	2.14	0.420	93.0	1.88	0.73	0.039	31.7	3.71	trace	trace	trace
	EFF-1C	0.73	5.17	0.708	323	1.70	0.87	0.051	54.4	3.21	trace	trace	trace
	EFF-1D	0.44	3.32	0.755	208	2.03	0.83	0.041	51.9	3.28	0.62	0.019	38.8
	EFF-1E	0.63	1.15	0.183	20.2	3.15	0.96	0.030	16.8	2.77	trace	trace	trace
	EFF-2B	0.81	2.22	0.274	79.3	3.06	0.85	0.028	30.4	2.75	trace	trace	trace
	EFF-2C	-	2.54	-	41.0	3.24	1.11	0.034	17.9	2.31	trace	trace	trace
	EFF-2D	0.78	5.38	0.690	245	3.38	1.31	0.008	59.5	2.32	0.23	0.010	10.5
	EFF-2E	0.51	5.17	1.014	103	3.48	1.23	0.035	24.6	2.28	0.24	0.010	4.80
	EFF-3B	0.44	6.05	1.38	106	3.07	1.41	0.046	24.7	2.23	0.33	0.015	5.79
	EFF-3C	0.56	5.23	0.934	-	8.83	0.94	0.011	-	2.44	trace	trace	trace
	EFF-3D	-	4.28	-	40.8	3.29	0.73	0.022	6.95	2.67	trace	trace	trace
	EFF-3E	-	2.27	-	36.0	3.71	0.64	0.017	10.2	2.87	trace	trace	trace

(Continued)

- Not determined (indicates insufficient sample).

Table C11 (Concluded)

Sample ID		V Total mg/l	V Oil & Grease Fraction µg/l	V % of Total	V ppm of dry Oil & Grease	Zn Total mg/l	Zn Oil & Grease Fraction µg/l	Zn % of Total	Zn ppm of dry Oil & Grease
Background Water	BW-B	-	-	-	-	1.12	0.85	0.076	213
	BW-C	-	-	-	-	1.13	0.62	0.055	207
Influent	INF-1B	3.21	1.38	0.043	2.02	18.5	2.73	0.015	3.99
	INF-1C	3.87	1.52	0.039	3.27	10.5	3.14	0.030	6.75
	INF-2B }	3.76	1.73	0.046	5.88	12.4	3.72	0.022	12.7
	INF-2C }	3.73				20.6			
	INF-3B }	4.33	2.50	0.067	5.01	22.9	3.51	0.019	7.03
	INF-3C }	3.17				13.7			
Effluent	EFF-1B	2.02	1.17	0.058	50.9	11.2	1.45	0.013	62.2
	EFF-1C	2.16	1.23	0.057	76.9	9.7	1.13	0.012	70.6
	EFF-1D	1.73	trace	trace	trace	9.8	0.82	0.008	51.3
	EFF-1E	1.58	2.03	0.128	35.6	9.2	1.06	0.012	18.6
	EFF-2B	1.63	0.93	0.057	33.2	6.8	0.93	0.014	33.2
	EFF-2C	1.66	0.98	0.059	15.8	7.3	0.74	0.010	11.9
	EFF-2D	1.21	0.73	0.060	33.2	12.1	trace	trace	trace
	EFF-2E	1.15	1.17	0.102	23.4	9.6	1.21	0.013	24.2
	EFF-3B	2.13	1.18	0.055	20.7	11.9	1.18	0.010	20.7
	EFF-3C	2.78	1.17	0.042	-	13.5	1.38	0.010	-
	EFF-3D	4.13	0.28	0.007	25.4	14.1	1.43	0.010	13.6
	EFF-3E	2.11	0.32	0.015	5.08	13.3	2.11	0.016	33.5

- Not determined (indicates insufficient sample).

TABLE C12

GRASSY ISLAND: CONCENTRATION OF METALS IN OIL AND GREASE FRACTION IN INFLUENT, EFFLUENT, AND BACKGROUND WATER SAMPLES

Sample ID		As				Cd				Cr			
		Total µg/l	Oil & Grease Fraction µg/l	% of Total	ppm of dry Oil & Grease	Total µg/l	Oil & Grease Fraction µg/l	% of Total	ppm of dry Oil & Grease	Total µg/l	Oil & Grease Fraction µg/l	% of Total	ppm of dry Oil & Grease
Background Water	BW-A	-	-	-	-	1.27	trace	trace	trace	-	-	-	-
Influent	INF-1B	-	0.88	-	.286	381	0.21	0.055	.068	-	0.77	-	.250
	INF-1C	-	0.93	-	.258	400	0.15	0.038	.042	-	0.73	-	.203
	INF-2B }	-	0.84	-	.163	580	trace	trace	trace	-	0.52	-	.101
	INF-2C }	-		-		710				-		-	
	INF-3B }	-	0.83	-	.134	330	0.14	0.052	.019	-	0.63	-	.086
	INF-3C }	-		-		210				-		-	
Effluent	EFF-1B	-	0.37	-	33.6	2.46	0.14	5.69	12.7	-	0.72	-	65.5
	EFF-1C	-	0.62	-	22.1	1.31	trace	trace	trace	-	0.63	-	22.5
	EFF-2B	-	0.60	-	46.2	2.89	trace	trace	trace	-	0.72	-	55.4
	EFF-2C	-	0.78	-	-	1.49	0.23	15.4	-	-	0.73	-	-
	EFF-3B	-	0.42	-	-	-	0.44	-	-	-	0.82	-	-
	EFF-3C	-	0.77	-	96.3	1.15	0.43	37.4	53.8	-	0.53	-	66.3

(Continued)

- Not determined (indicates insufficent sample).

Table C12 (Continued)

Sample ID		Cu				Fe				Mn			
		Total mg/l	Oil & Grease Fraction µg/l	% of Total	ppm of dry Oil & Grease	Total mg/l	Oil & Grease Fraction µg/l	% of Total	ppm of dry Oil & Grease	Total mg/l	Oil & Grease Fraction µg/l	% of Total	ppm of dry Oil & Grease
Background Water	BW-A	0.27	0.91	0.337	28.4	0.03	2.34	7.8	73.1	-	trace	-	trace
Influent	INF-1B	20.1	5.15	0.026	1.67	6830	5.83	0.00008	1.89	15.6	0.78	0.005	.257
	INF-1C	26.7	4.32	0.016	1.20	5020	14.38	0.0003	3.99	17.3	0.66	0.004	.183
	INF-2B }	23.3	4.91	0.021	.951	5080	9.72	0.0002	1.88	28.4	0.64	0.002	.124
	INF-2C	24.3				5780				22.6			
	INF-3B }	21.1	4.48	0.023	.615	6130	13.56	0.0002	1.86	35.2	0.89	0.002	.122
	INF-3C	18.7				4870				37.3			
Effluent	EFF-1B	1.63	3.87	0.237	352	37.8	1.17	0.003	106	1.08	0.13	0.012	11.8
	EFF-1C	1.87	3.10	0.166	111	48.2	5.79	0.012	207	0.73	3.58	0.490	128
	EFF-2B	1.14	4.07	0.357	313	50.1	1.68	0.003	129	0.58	0.16	0.028	12.3
	EFF-2C	1.39	3.43	0.247	-	51.3	3.47	0.007	-	0.63	0.28	0.044	-
	EFF-3B	1.93	3.52	0.182	-	47.2	3.28	0.007	-	0.23	0.38	0.165	-
	EFF-3C	1.76	2.78	0.158	348	46.3	4.47	0.010	559	0.38	0.11	0.029	13.8

(Continued)

- Not determined (indicates insufficent sample).

Table C12 (Continued)

Sample ID		Ni Total mg/l	Ni Oil & Grease Fraction µg/l	Ni % of Total	Ni pmm of dry Oil & Grease	Pb Total mg/l	Pb Oil & Grease Fraction µg/l	Pb % of Total	Pb ppm of dry Oil & Grease	Ti Total mg/l	Ti Oil & Grease Fraction µg/l	Ti % of Total	Ti ppm of dry Oil & Grease
Background Water	BW-A	0.004	1.40	35.0	43.8	0.047	trace	trace	trace	trace	trace	trace	trace
Influent	INF-1B	9.3	3.31	0.036	1.07	11.8	3.27	0.028	1.06	8.61	0.83	0.010	.269
	INF-1C	7.8	4.13	0.053	1.15	12.1	1.57	0.013	.436	7.65	0.67	0.009	.186
	INF-2B	11.7	6.21	0.046	1.20	13.7	2.29	0.017	.443	7.53	1.53	0.020	.296
	INF-2C	15.3				12.5				8.34			
	INF-3B	14.3	4.65	0.037	.638	13.3	3.47	0.029	.476	9.21	2.78	0.032	.382
	INF-3C	10.6				10.3				8.43			
Effluent	EFF-1B	0.82	3.57	0.435	325	0.182	0.87	0.478	79.1	0.27	trace	trace	trace
	EFF-1C	0.87	21.23	2.44	758	0.079	0.75	0.949	26.8	0.19	0.23	0.121	8.21
	EFF-2B	0.32	3.35	1.05	258	0.098	4.14	4.22	318	0.37	0.54	0.146	41.5
	EFF-2C	0.45	2.79	0.62	-	0.046	0.99	2.15	-	0.25	trace	trace	trace
	EFF-3B	0.17	6.68	1.58	-	0.155	0.73	0.471	-	0.30	0.63	0.21	-
	EFF-3C	0.57	2.52	0.442	315	0.068	1.14	1.68	143	0.16	trace	trace	trace

(Continued)

- Not determined (indicates insufficient sample).

Table C12 (Concluded)

Sample ID		V				Zn			
		Total mg/l	Oil & Grease Fraction µg/l	% of Total	ppm of dry Oil & Grease	Total mg/l	Oil & Grease Fraction µg/l	% of Total	ppm of dry Oil & Grease
Background Water	BW-A	0.003	-	-	-	0.23	0.84	0.365	26.3
Influent	INF-1B	5.13	0.55	0.011	.179	17.7	2.44	0.014	.792
	INF-1C	5.19	0.31	0.006	.086	16.8	2.67	0.016	.742
	INF-2B } INF-2C	5.61 6.09	trace	trace	trace	20.7 37.1	2.12	0.007	.428
	INF-3B } INF-3C	6.21 4.39	0.72	0.014	.099	35.6 17.1	2.83	0.011	.388
Effluent	EFF-1B	0.17	0.11	0.065	10.0	0.40	1.74	0.453	158
	EFF-1C	0.31	trace	trace	trace	0.44	7.87	1.79	281
	EFF-2B	0.12	0.17	0.142	13.1	0.94	0.96	0.102	73.8
	EFF-2C	0.18	0.28	0.156	-	0.33	1.83	0.555	-
	EFF-3B	0.15	5.06	3.37	-	0.38	2.15	0.566	-
	EFF-3C	0.32	0.43	0.134	53.8	0.36	1.93	0.536	241

- Not determined (indicates insufficient sample).

TABLE C13

PINTO ISLAND: CONCENTRATION OF EXCHANGEABLE METALS AND ACETIC ACID EXTRACTS IN INFLUENT AND EFFLUENT SAMPLES

Sample ID		Exchangeable Metals (mg/kg dry sediment)									
		As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Zn	V
Influent	INF-1B	0.22	0.011	0.28	0.22	0.28	178	0.13	0.10	1.3	trace
	INF-1C	0.16	0.008	0.25	0.16	0.45	185	0.13	0.06	0.1	trace
	INF-2B	0.21	0.010	0.25	0.21	0.21	177	0.12	0.05	0.1	trace
	INF-2C	0.34	0.016	0.21	0.15	0.17	170	0.23	0.09	0.1	trace
	INF-3B	0.14	0.005	0.14	0.13	0.12	91	0.08	0.05	0.08	trace
	INF-3C	0.08	0.007	0.15	0.16	0.89	124	0.08	0.06	0.08	trace
Effluent	EFF-1B	0.11	0.042	0.19	0.32	0.25	11.6	0.23	0.12	3.8	trace
	EFF-1C	0.30	0.039	0.17	0.26	0.07	8.9	0.22	0.10	3.3	trace
	EFF-1D	0.34	0.041	0.22	0.39	0.10	7.7	0.31	0.11	3.5	trace
	EFF-1E	0.27	0.060	0.21	0.30	0.07	8.2	0.30	0.12	3.8	trace
	EFF-2B	0.25	0.067	0.46	0.50	0.17	26.7	0.38	0.17	6.3	trace
	EFF-2C	0.43	0.088	0.24	0.53	0.27	10.4	0.16	0.11	5.3	trace
	EFF-2D	0.21	0.027	0.21	0.25	0.08	6.5	0.04	0.08	3.1	trace
	EFF-2E	0.31	0.050	0.25	0.37	0.12	5.9	0.16	0.13	3.0	trace
	EFF-3B	0.27	0.034	0.15	0.20	0.05	56.8	0.17	0.03	4.0	trace
	EFF-3C	0.26	0.048	0.35	0.55	0.44	119	0.48	0.09	11.4	trace
	EFF-3D	0.23	0.045	0.21	0.35	0.06	128	0.29	0.10	8.2	trace
	EFF-3E	0.23	0.081	0.18	0.41	0.07	128	0.29	0.14	10.9	trace

Table C13 (Concluded)

Sample ID		Acetic Acid Extract (Metal Carbonates) (mg/kg dry sediment)									
		As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Zn	V
Influent	INF-1B	0.55	0.220	0.90	1.75	2480	243	1.83	2.71	80.8	3.4
	INF-1C	0.62	0.110	1.11	0.69	3250	284	2.44	2.50	60.4	4.6
	INF-2B	0.33	0.091	0.82	0.23	4180	301	1.44	1.65	39.2	4.7
	INF-2C	0.23	0.034	0.96	0.21	5520	365	2.12	1.25	30.6	5.3
	INF-3B	0.22	0.039	0.60	0.26	2390	143	1.11	2.38	22.3	3.3
	INF-3C	0.31	0.035	1.02	0.28	3670	142	0.86	2.67	32.1	4.1
Effluent	EFF-1B	0.28	0.133	0.70	2.85	1940	298	1.71	1.25	61.9	trace
	EFF-1C	0.33	0.187	0.70	2.83	1810	268	1.57	1.18	56.6	trace
	EFF-1D	0.39	0.121	0.70	2.79	1820	312	1.55	1.39	54.7	trace
	EFF-1E	0.32	0.199	0.92	2.24	1790	285	2.34	1.14	46.7	trace
	EFF-2B	0.63	0.142	0.79	3.33	2520	396	1.67	1.67	49.2	trace
	EFF-2C	0.29	0.106	0.67	2.77	1920	320	1.70	1.60	48.4	trace
	EFF-2D	0.23	0.176	0.59	2.29	1540	366	2.10	1.22	50.4	trace
	EFF-2E	0.40	0.115	0.74	3.25	2210	338	1.30	1.37	49.7	trace
	EFF-3B	0.17	0.136	0.68	1.76	1360	136	1.22	2.00	50.9	0.6
	EFF-3C	0.24	0.109	0.74	3.54	1580	66	1.62	2.58	49.4	0.8
	EFF-3D	0.27	0.206	1.07	3.42	2300	244	2.72	2.68	87.3	1.6
	EFF-3E	0.23	0.090	1.04	4.61	2080	68	2.08	2.44	56.9	1.4

TABLE C14

GRASSY ISLAND: CONCENTRATION OF EXCHANGEABLE METALS AND ACETIC ACID EXTRACTS IN INFLUENT SAMPLES

Sample ID		Exchangeable Metals (mg/kg dry sediment)									
		As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Zn	V
Influent	INF-1B	0.12	0.017	0.11	0.21	0.16	41.8	0.99	0.63	3.2	trace
	INF-1C	0.14	0.031	0.14	0.24	0.11	42.9	1.35	0.98	7.3	trace
	INF-2B	0.13	0.021	0.13	0.25	0.14	28.6	19.5	0.73	6.4	trace
	INF-2C	0.13	0.021	0.11	0.16	0.11	23.2	12.5	0.45	3.5	trace
	INF-3B	0.17	0.025	0.12	0.12	0.14	23.6	15.0	0.56	3.4	trace
	INF-3C	0.15	0.034	0.14	0.16	0.05	27.5	13.4	0.63	5.0	trace

Sample ID		Acetic Acid Extract (Metal Carbonates) (mg/kg dry sediment)									
		As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Zn	V
Influent	INF-1B	0.66	0.149	14.07	0.75	6480	319	21.1	3.97	171	4.2
	INF-1C	0.84	0.310	11.75	0.68	5200	326	19.6	11.29	247	2.7
	INF-2B	0.52	0.170	16.36	0.80	7380	273	36.8	0.23	203	1.6
	INF-2C	0.42	0.090	14.25	0.54	5890	228	35.5	0.19	137	0.8
	INF-3B	0.32	0.090	10.72	0.75	8020	253	31.1	0.26	112	0.8
	INF-3C	0.36	0.100	9.23	0.89	7700	267	37.4	0.26	122	0.4

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Lu, James C S
Characterization of confined disposal area influent and effluent particulate and petroleum fractions / by James C. S. Lu ... [et al.], Environmental Engineering Program, University of Southern California, Los Angeles, Calif. Vicksburg, Miss. : U. S. Waterways Experiment Station ; Springfield, Va. : available from National Technical Information Service, 1978.
iv, 45, [128] p. : ill. ; 27 cm. (Technical report - U. S. Army Engineer Waterways Experiment Station ; D-78-16)
Prepared for Office, Chief of Engineers, U. S. Army, Washington, D. C., under Contract No. DACW39-76-C-0038 (DMRP Work Unit No. 2D04)
References: p. 44-45.

1. Containment areas. 2. Dredged material. 3. Dredged material disposal. 4. Effluents. 5. Influents. 6. Particulates. 7. Petroleum. 8. Sampling. 9. Sedimentation. 10. Trace metals. 11. Waste disposal sites. 12. Water quality. I. Los Angeles. University of Southern California. II. United States. Army. Corps of Engineers. III. Series: United States. Waterways Experiment Station, Vicksburg, Miss. Technical report ; D-78-16.
TA7.W34 no.D-78-16